APPENDIX A

Chronology and Technical Basis of the DFG-NMFS Draft Guidelines

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APPENDIX A

CHRONOLOGY AND TECHNICAL BASIS OF THE DFG-NMFS DRAFT GUIDELINES

This section describes the chronology and technical basis of the California Department of Fish and Game (DFG) and the National Marine Fisheries Service (NMFS) "Draft Guidelines for Maintaining Instream Flows to Protect Fisheries Resources Downstream of Water Diversions in Mid-California Coastal Streams" (DFG-NMFS (2002) Draft Guidelines). It is based largely on data and information provided by State Water Board staff, information obtained via internet searches, and information available in scientific publications. In addition, a meeting with State Water Board staff and representatives of NMFS and DFG was held on May 16, 2005 and provided supplemental information regarding the developmental history of the DFG-NMFS Draft Guidelines as well as the scientific basis for certain components of the guidelines.

The genesis for the DFG-NMFS Draft Guidelines began in 1994 when the State Water Board's Division of Water Rights began an evaluation of the impacts on flows and the aquatic ecosystem of the Russian River basin that could be attributed to water demands from permitted and un-permitted diversions and instream structures. At the time, it was estimated there were 70 pending water right applications in the watershed, and 1404 permitted water rights. The Division held a series of public workshops in 1995 and 1996 to solicit comments and recommendations regarding possible courses of action that could be taken while protecting fishery and other resources, and initiated hydrologic modeling of the basin to predicted unimpaired and impaired flows.

An important workshop held on November 7, 1996 convened members from various agencies and groups to coordinate actions to protect anadromous fish in the Russian River basin. This was done, in part in response to the pending listings of a number of anadromous salmonids under the federal ESA. Attendees included NMFS, DFG, U.S. Army Corps of Engineers (USACE), Sonoma County Water Agency (SCWA), North Coast Regional Water Quality Control Board (RWQCB), California Coastal Conservancy (CCC), Sonoma County, Mendocino County, and others. Representatives from each organization presented a status report of ongoing studies, management plans, and watershed planning measures.

A.1 RUSSIAN RIVER STAFF REPORT (SWRCB 1997) RECOMMENDATIONS AND TECHNICAL BASIS

State Water Board staff reviewed the information generated by the workshops and studies, and subsequently developed a draft Russian River Staff Report (SWRCB 1997). The report summarized current major study and planning efforts, described a hydrologic model and its output, recommended a minimum winter bypass flow equal to 60% of the average annual unimpaired flow ($0.6Q_m$), identified a suitable diversion season for tributaries of the Russian

River extending from December 15 to March 31, and proposed various procedures for processing pending applications. The problem of maintaining instream flows for fish in the mainstem Russian River was left to the SCWA, which was subject to decision D-1610, which addressed provision of minimum instream flows for various seasons and water year types.

A.1.1 Diversion Season

The December 15 – March 31 diversion season stipulation reflected biological timing (or, periodicity) of various anadromous salmonid lifestages, and the availability of water based on an analysis of five gages in the Russian River basin (SWRCB 1997). The gage analysis indicated that the rainy season generally extended from November 15 to March 31. The December 15 date reflected the need to ensure that there was no reduction in pulse flows in the tributaries and mainstem of the Russian River in the early fall. Adult coho salmon and steelhead trout were noted in general to arrive at the mouth of the river in early fall and begin migrating upstream in November in response to storm pulses. An analysis of hydrologic flow and precipitation records indicated that more sustained winter flows generally did not occur until after mid-December. It was recommended that no diversions be permitted during the initial migration period when the availability of flows sufficient for upstream migration was less certain (SWRCB 1997). However, State Water Board staff concluded that pulse flows in the tributaries would not measurably affect flows in the mainstem Russian River.

The March 31 date was identified in consideration of late-incubating steelhead embryos and downstream migrating coho and steelhead juveniles. The steelhead incubation period was noted to extend into May, while the period for downstream migration of both species extended into June. Flows were considered unlikely to exceed the minimum bypass spawning flow in April in all years, and thus the cutoff-date for new diversions was set as March 31 (SWRCB 1997), analogous to the rationale used to identify the December 15 date.

A.1.2 Flow Magnitudes

The Russian River Staff Report (SWRCB 1997) proposed a minimum winter bypass flow equal to 60% of the mean annual unimpaired flow. This flow level was based on habitat needs of spawning steelhead, which were considered to require more flow than spawning coho. Steelhead spawning was reported to occur over the January-April period, and coho spawning in December and January. The period over which the 60% criterion applied was from November through April, inclusive, reflecting both upstream migration and spawning periodicities of steelhead.

The identification of the 60% criterion was based on a review of the results of instream flow studies conducted in two major tributaries to the Russian River, Big Sulphur Creek and Dry Creek, and in two nearby basins, Brush Creek and Lagunitas Creek, with drainage areas ranging between approximately 16-217 square miles (Table A-1). Most of the studies involved the use of the Physical Habitat Simulation (PHABSIM) system of the U.S. Fish and Wildlife Service's Instream Flow Incremental Methodology (IFIM). The product of PHABSIM is a set of habitat-flow curves, with habitat represented by a habitat suitability-weighted measure of area termed Weighted Usable Area (WUA). The recommended steelhead spawning flows from the various studies analyzed ranged between approximately 70-110% of the mean annual flow in the four streams (Table A-1).

Table A-1. Summary of Optimum Steelhead Spawning Habitat Flows Derived from Previous Instream Flow Studies and Considered by State Water Board Staff (SWRCB 1997) in Development of Proposed Measures to Protect Anadromous Salmonids (data from Smith 1986; Snider 1985; SWRCB 1997).

Stream/Location	Approximate Drainage Area (mi^2)	Average Annual Flow (Q_m; cfs)	Study Method/Basis	"Optimum" Spawning Flow as Percent of Q_m
Big Sulphur Creek Near Mouth	~86	81	PHABSIM: Peak of WUA-Flow Curve	104%
Dry Creek Below Warm Springs Dam	~217	399	Correlation of Spawning Habitat Area With Flow	100%
Brush Creek Near Mouth	~16	44	PHABSIM: Peak of WUA-Flow Curve	114%
		44	DFG Recommendation	68%
Lagunitas Creek Taylor State Park	~38	69	PHABSIM: Peak of WUA-Flow Curve	72%

This range of flows was compared qualitatively with other various flow levels. A comparison was made to the Tennant (1976) method, where providing 60-100% of Q_m reportedly would provide optimum habitat for fisheries. A general statement was attributed to M. Healey that the protectiveness of instream flows becomes more uncertain as flows drop below about 70% of natural levels.

Another comparison was made involving the case of Mono Lake tributaries on the east side of the Sierras, where flows during dry years were considered most critical to fish. It was assumed that maintaining flows representative of dry year conditions every year would not seriously harm anadromous fish populations. The State Water Board specified in Decision D-1631 that flows in Mono Lake tributaries should provide 80% of maximum WUA in dry years. Corresponding flows established for Lee Vining Creek in particular were roughly 55% of the average annual (presumably unimpaired) flow during the high flow period in dry years. The Russian River Staff

Report proposed following the dry year criteria established under D-1631 for Mono Lake tributaries, and noted from the PHABSIM results for spawning steelhead in Big Sulphur Creek that this likewise corresponded approximately to 0.6 Q_m (SWRCB 1997).

For other times of the year, the Russian River Staff Report (SWRCB 1997) proposed that a minimum flow equal to 30% of the average annual flow was needed to provide summer rearing habitat for steelhead and coho juveniles, which usually spend at least one year in freshwater before outmigrating to the ocean. The 30% criterion was based on similar reasoning as above for the winter flow criterion, to provide good rearing conditions during dry years. Since this flow level is typically greater than what is available during the May-October period in Russian River tributaries, the Russian River Staff Report recommended that no new diversions be allowed from tributaries during this period.

A.1.3 Other Flow-Related Considerations and General Application of Methodology

The Russian River Staff Report (SWRCB 1997) identified several other flow-related needs. Preservation of high pulse flows for gravel recruitment and transport was identified as important, but the report did not recommend a specific flow level or prescription method. It was recommended that specific permit terms be developed on a case-by-case basis. The need to facilitate salmon and steelhead migration was also identified. Accordingly, the Russian River Staff Report (SWRCB 1997) recommended that projects resulting in a migration barrier not be approved. On-stream projects located above existing permanent barriers, or on streams that do not provide habitat for coho or steelhead, could be approved on a case-by-case basis.

In summary, the Russian River Staff Report (SWRCB 1997) recommended that the proposed instream flow methodology apply primarily to relatively small projects on tributary streams, and that project-specific studies may be needed on larger projects. However, no guidance was given regarding specific size thresholds for stream channels and projects.

A.1.4 Extension of Russian River Staff Report (SWRCB 1997) Methodology to the Navarro River Basin

The State Water Board's Division of Water Rights expanded the area covered by the 1997 staff report to the Navarro River basin in 1998 when it published its draft decision on five pending water right applications for the Navarro River and several tributaries (SWRCB 1998b). The draft decision followed investigations of various complaints and publication of a staff report containing investigation findings and recommendations (SWRCB 1998a). The Navarro draft decision included the additional consideration of riparian rights, prohibiting additional diversion of water for use where riparian rights already existed (SWRCB 1998b).

A.2 EXTERNAL REVIEWS OF THE RUSSIAN RIVER STAFF REPORT (SWRCB 1997)

The Russian River Staff Report (SWRCB 1997) was sent out to approximately 800 parties for review and comment. Primary parties providing substantive comments pertaining to the biological, physical, and implementation bases of the methodology included McBain and Trush (1998; representing Trout Unlimited, TU) and NMFS. While they noted that the proposed approach represented steps in the right direction, McBain and Trush (1998) commented on points where their opinion or interpretation differed and raised several questions that remained unanswered. The NMFS provided comments in October 1998. State Water Board staff subsequently responded to comments and opened discussions with NMFS and TU. McBain and Trush (1999) provided additional comments and recommended an alternative approach. During the process, as described above, the area of concern was expanded to also include the Navarro River basin and other north coastal watersheds. The comments are summarized thematically below. Specific, proposed alternative approaches that arose during this process are described in Section A.3.

A.2.1 Seasonal Timing of Diversions

There was general concurrence regarding the selected diversion window. Limiting diversion to after the first winter storms and preserving late-spring flow variation was considered extremely important for upstream and downstream migration of anadromous salmonid adults and smolts. The consensus was that tributaries of the Russian River should be listed as fully appropriated for the period April 1 to December 14. It was noted, however, that the effects of existing water rights during that period were not covered by the guidelines. In addition, it was argued that providing flows strictly for spawning habitat between December 15 and March 31 would neglect upstream passage needs during that period.

A.2.2 Magnitude of Diversions and Instream Flows Relative to Water Availability

An important criticism of the proposed methodology was that it did not account for potential cumulative impacts of diversions in the tributaries or on the mainstem Russian River. An approach that focused only on the individual, incremental effect of a diversion and not the cumulative effect of multiple diversions posed a long-term risk to maintaining sufficient instream flows, analogous to "death by a thousand cuts." In addition, the methodology proposed in the staff report did not provide the means for limiting future diversion in specific streams. It was recommended that as part of the requirements, pending and existing diversions be mapped onto each basin's drainage network and quantified to assess total projected demand.

A.2.3 Basis of Recommended Instream Flow Magnitude

There were questions concerning the definition of what constituted an acceptable minimum instream flow. The definition in the Russian River Staff Report (SWRCB 1997) hinged on a methodology to define flow, and how that flow corresponded to low flow hydrologic measures. It was noted that the PHABSIM results evaluated in the staff report were for relatively large channels and could not be applied directly to smaller channels because of the influence of scale. It has been generally recognized that the ratio of PHABSIM-based flow recommendations to annual flow, decreases with increasing channel size (e.g., Hatfield and Bruce 2000). Hence, a flow resulting in maximum habitat area (or some percentage thereof), as represented for example by a metric such as PHABSIM's WUA, in one size stream generally will not represent the same percentage of average annual flow in another, larger or smaller stream. The assumption that there is a typical WUA-flow curve for all streams was questioned, as was setting the flow resulting in 80% of maximum spawning WUA as a suitable target. The concept and existence of an optimum flow was also questioned, reflecting absence of research showing this level leaves fish populations in good condition and the observation that areas with suitable habitat may shift location across the channel as discharge increases or decreases. It was noted that the instream flow studies reviewed indicated that optimal flows for salmonid spawning were generally much higher than the $0.6Q_m$ level.

Additional correspondence with results from the Tennant Method (Tennant 1976) was not considered to be a form of validation. The reason was given that the Tennant results represented more snowmelt dominated streams than project area streams characterized by greater hydrologic variability (i.e., more flashy). Similarly, the analogy to snowmelt-driven streams in the Mono Lake case was questioned.

The hypothesis that providing dry year flows in all years would be sufficient to sustain anadromous salmonid populations was also criticized on several bases. Imposing a dry year criterion was thought to potentially place threatened salmonid populations at considerable risk. Salmonid populations were thought to rely on average and wet years to allow them to rebound from dry year effects. Moreover, the fact that coho and steelhead populations were near the southern fringe of their latitudinal distributions was associated with an increased ecological risk, where environmental conditions were closer to adverse levels controlling distribution overall. Environmental perturbations were considered to have a greater relative effect on population sustainability of anadromous salmonids nearer their distribution margins than in areas within the central latitudes. In addition, specific examples comparing winter base flows in dry and other years indicated that allocating dry year flows to all years would reduce basin-wide distributions of fish and keep portions of the active channel unseasonably dry.

A.2.4 Effects of Instream Flows on Steelhead and Coho Migration and Spawning

McBain and Trush (1998, 1999) provided examples where the $0.6Q_m$ winter baseflow standard would reportedly result in sub-standard spawning habitat levels for steelhead populations in specific streams, that could lead to increased egg mortality in average and wet years by restricting redds created during the diversion period to the channel centerline, which would be at greater risk of scour during storm events. Redds created prior to December 15 were considered at risk of stranding once diversion began. Analyses of flow hydrographs for Russian River tributaries indicated that the standard would reduce naturally sustained winter flows thought to be needed for spawning by anadromous salmonids.

In addition, examples were given where the corresponding water level would result in water depths that would be too shallow to allow upstream migration of adult steelhead within smaller tributaries during base flow periods. The issue of scale was identified, where smaller channels were associated with a higher flow range for upstream passage than larger channels, sometimes in the more extreme flow range. The need to identify downstream passage barriers as part of the application process was noted.

A.2.5 Other Instream Flow Needs

It was noted that the proposed methodology did not include provisions for channel maintenance flows, which are important for mobilizing and transporting gravel and fine sediments, and for preventing riparian encroachment. These processes influence habitat quantity and quality for spawning and other steelhead lifestages. Other identified needs included ensuring groundwater recharge and side channel maintenance. Permitting of on-stream impoundments without suitable mitigation was noted to interrupt sediment transport, leading to downstream degradation of steelhead spawning habitat.

The Russian River Staff Report's (SWRCB 1997) methodology was criticized for not sufficiently considering biological needs during the winter diversion period. For example, there were no specific elements within the methodology to address the importance of juvenile over-wintering habitat, which has been proposed in the scientific literature to limit coho population size in particular. The methodology was also thought to be insufficient for preserving the range of important ecological processes occurring over different water years and watershed sizes. However, no specific recommendations were given that would link flow to these other processes.

A.2.6 Implementation, Monitoring, and Enforcement

The actual protectiveness of the Russian River Staff Report's (SWRCB 1997) methodology was considered dependent on the extent to which they were effectively implemented and followed. The proposed approach was criticized for the absence of relevant, specific measures for implementation and for not providing recommendations for effective monitoring and enforcement. Implementation issues were identified that could lead to non-compliance, including the need for better and more widespread stream gaging, the inability to forecast a water year in a coastal system compared with snowmelt basins, incomplete inventories of all cumulative existing water uses, and inability of existing flow models to permit real time flow allocation and enforcement. Relying on a proposed 2 cfs limit on pump capacity was likewise considered insufficient for controlling overall diversions. Another perceived critical implementation issue related to whether a stream was classified as fish-bearing or not, especially with respect to anadromous salmonids. Streams that were subject to human-caused blockages, through either diversion or presence of physical barriers including culverts in particular, could still provide habitat locally, or affect flows and habitats downstream.

A.3 PROPOSED ALTERNATIVES TO THE RUSSIAN RIVER STAFF REPORT (SWRCB 1997): JANUARY 31, 2000 WORKSHOP

During the review process, NMFS, DFG, and TU began developing alternative instream flow guidelines. In light of this, the State Water Board convened a peer review workshop held on January 31, 2000 to solicit further development and review of the suite of methodologies under consideration. A peer review panel, consisting of Dr.'s Peter Moyle (UC Davis), Matt Kondolf (UC Berkeley), and John Williams (private), was convened to host the workshop and write a report on its outcome. The primary proposals of DFG-NMFS and TU, and supporting details, are summarized below to identify the general collective thinking behind the development of instream flow guidelines for the study area, followed by a summary of the peer review panel's report and recommendations. The process was fluid in the sense that the various participants continued to modify their respective approaches through a series of discussions, including after the workshop. The sum of the information and recommendations were collectively considered in the development of the ultimate DFG-NMFS Draft Guidelines.

A.3.1 DFG-NMFS (2000) – Initial Draft Guidelines

The NMFS was supportive of the Russian River Staff Report's (SWRCB 1997) concept of a bypass flow policy identifying a minimum stream flow below which new withdrawals would be prohibited during winter months. However, NMFS considered a standard setting equal to $0.6Q_m$ to not be protective of steelhead trout, for similar reasons as summarized in Section A.2. In addition, NMFS considered it important to set guidelines for higher flows needed to manage fine sediment flushing and facilitate migratory movements of adult and juvenile anadromous fishes.

The NMFS (2000) noted that, given the potential variability of stream flow and habitat-flow relations in Russian River tributaries, any flow standard applied without site-specific information and used over a wide geographic area should be conservatively, yet reasonably (with respect to allowing diversion) biased toward salmon conservation. A bypass flow guideline was proposed for tributaries that equaled the February median flow. This level was thought to approximate flows needed to protect salmonid populations, and provide a conservative alternative to the 1997 staff report's $0.6Q_m$ recommendation, and still allow diversions to occur during the winter period.

The month of February was chosen because it was generally the month with the highest median flow in Russian River tributaries. The NMFS reasoned that maintenance of the February median flow should also protect spawning and egg incubation habitat of salmonids in other months, when flows were less.

A median statistic was considered preferable to a mean because it better reflected flow duration, and was not influenced as strongly by infrequent, high flow events. Review of 81 annual records of winter flows in five tributaries of the Russian River indicated that the February median flow led to more, sustained winter flows potentially useful to spawning salmonids than the $0.6Q_m$ level. A standard based on a median flow was also noted to provide for water diversions during the winter period.

Diversion only during high flows was thought to not significantly impact steelhead spawning and egg incubation, because such flows are not sustained. Furthermore, diversion of flow during these high flow periods was thought to reduce the incidence of redds being created nearer the channel margins during high flows, and thus reduce the potential for redd dewatering.

The NMFS (2000) recommended that site-specific studies be required for those seeking a minimum bypass flow lower than the February median; such studies would need to demonstrate that a lower bypass flow would have no significant adverse effect on aquatic resources.

The issue of cumulative effects was addressed indirectly. The NMFS (2000) recommended that the bypass flow be maintained at diversions in tributary headwaters even if salmonids and/or their habitat are not located in the channel immediately downstream of the diversion point. It was noted that headwater tributaries may be important areas for the production or transport of invertebrate foods that subsequently drift downstream to rearing juveniles. In addition, NMFS noted that headwater tributaries also contribute flow to downstream reaches that may support salmonids, and that cumulative downstream impacts could occur.

In recognition of the need to maintain some degree of natural flow variability and high stream flows for ecological and channel maintenance purposes, NMFS (2000) proposed limiting the instantaneous rate of diversion to less than 20% of the winter 20% exceedance flow, evaluated cumulatively for all diversions located at, and upstream of a diversion site. This flow would be maintained in conjunction with the February median bypass flow. A review of hydrographs for tributaries of the Russian River indicated that stream flow is especially high during about 20% of the time during the winter months. It was proposed that removal of a portion of this high flow would probably have no adverse effect on salmonids or stream ecosystem function. It was suggested that the proposed limit would (a) preserve natural high flow events needed for channel maintenance, (b) preserve days with intermediate flows, and (c) provide substantial quantities of water to irrigators and other water users.

In summary, NMFS (2000) and DFG-NMFS (2000) recommended that the State Water Board modify the water diversion approach proposed in the Russian River Staff Report (SWRCB 1997) by incorporating the following measures for coastal basins ranging from the Mattole River to the north, down the coast and into San Pablo Bay, up to and including the Napa River basin:

1. Diversions in streams with anadromous salmonid habitat that withdraw more than 3 cfs or 200 acre-ft/yr require assessments of: instream flow needs for fish habitat and channel maintenance; existing level of diversion-related impairment and limiting factors; and development of an effectiveness monitoring plan, all subject to agency review and approval;
2. For smaller diversions, use the February median flow as the minimum winter bypass flow guideline;
3. The natural hydrograph should be protected by limiting the cumulative instantaneous rate of withdrawal to 15% of the winter 20% exceedance flow during the period December 15-March 31, subject to a limiting cumulative rate of withdrawal that does not appreciably diminish (qualified as <5% of) the natural hydrograph flows needed for channel maintenance (e.g., around the 1.5- to 2-year flood events) and upstream fish passage; reduced from 20% of the 20% exceedance flow after discussions with State Water Board staff; (DFG-NMFS 2000; NMFS 2000);
4. Coordinate permitting so that cumulative withdrawals from upstream reaches do not exceed the maximum instantaneous withdrawal rate at any point on the stream;
5. Ensure that fish passage and screening requirements are met;
6. Avoid additional permitting of small on-stream reservoirs; and
7. Require the applicant to identify all other water rights and their basis in streams potentially affected by the proposed diversion, and provide evidence of compliance and effectiveness.

The flow levels specified above applied to cases where site-specific studies were not conducted. Studies that demonstrated another flow level as sufficient and not adversely affecting salmonids and their habitat could be used to justify a diversion rate otherwise not permitted under the guidelines above.

A further exemption was provided in cases where the following conditions were all met: (i) the proposed diversion was located in a stream where aquatic fauna were not historically present, per Class III designation under 14 CCR 916.5, Table 1 (i.e., no aquatic life present, water course showing evidence of being capable of sediment transport downstream to fish-bearing waters under normal high water flow conditions); (ii) the project would not lead to a cumulative diversion rate exceeding 10% of the natural instantaneous flow in any reach where fish are at least seasonally present ("cumulative" was defined to include riparian water rights), and (iii) the project would not lead to dewatering of a fishless stream supporting other aquatic fauna.

The DFG-NMFS (2000) identified the need to corroborate assumptions used in developing the guidelines through compliance and effectiveness monitoring. As part of this, it was considered essential that all existing diversions be quantified prior to the issuance of new permits to prevent over-allocation, and that stream gages be installed at key locations to monitor compliance. The State Water Board, DFG and NMFS were called to cooperatively develop and implement a plan to monitor the effectiveness of the proposed standards, and make refinements based on the information collected. In addition, the need for enforcement was identified, through stream gaging and random compliance inspections.

A.3.2 Trout Unlimited/McBain and Trush (2000) Proposal

The Trout Unlimited (TU) proposal was the product of a number of previous reviews related to the State Water Board (SWRCB 1997) Russian River basin staff report, the subsequent draft decision for the Navarro River basin (SWRCB 1998b), and the initial NMFS (2000) and DFG-NMFS (2000) draft guidelines for these and other coastal basins north of San Francisco and south of the Eel River. A set of initial recommendations was made (McBain and Trush 1999), followed by a revised, more comprehensive set (MTTU 2000). The newer recommendations reflected additional data analyses and various discussions with the agencies leading up to the January 31, 2000 peer review workshop, at which time the revised TU protocols were also presented.

Major initial recommendations (McBain and Trush 1999) were:

1. Protocol needs to include mechanisms to facilitate within-year (e.g., variable hydrographs) and interannual (e.g., wet vs. dry year protocols) flow variation, as opposed to what MTTU (2000) later called managing for a "typical" year;
2. More protective measures are needed for juvenile rearing habitat and channel maintenance; flow range should vary at a minimum between 10% exceedance base flow and 70% of the bankfull flow ($0.7Q_{BF}$) flow;
3. Proposed guidelines should be applied similarly for streams independent of the presence of anadromous fish; some streams could contain salmonids pending correction of artificial passage barriers, and other streams provide flows needed farther downstream;
4. Measures are needed to ensure that on-stream reservoirs pass unobstructed flows outside the diversion window, and new on-stream reservoirs should not be permitted;

5. Should ensure that cumulative diversion rates do not exceed the maximum permissible for the watershed;
6. Implementation and effectiveness monitoring are needed to assure fish habitats are not adversely impacted through application of specified criteria; and
7. Enforcement should be conducted at a minimum of on an annual, random basis.

McBain and Trush (1999) and MTTU (2000) stated that use of active channel discharge (Q_{AC}) could be defended on a geomorphic basis. It was stated that the Q_{AC}: (a) was the approximate threshold flow for sediment transport, (b) left a geomorphic signature in the channel consisting of a bench of coarse particles packed in a matrix of sand and fine gravel that originates at the active channel crest and extends approximately to the bankfull stage height, (c) limited woody riparian encroachment as indicated by the absence of white alder roots below this level, and (d) had important significance for adult salmonid access and juvenile rearing. The extent of white alder roots was stated as forming the active channel bench in northern California streams along straight reaches, preventing the channel from widening and concomitantly increasing the potential for redd stranding.

The value of the proposed Q_{AC} was reported to have an annual exceedance probability of ~10%. McBain and Trush (1999) noted that Caltrans used a higher fish passage flow standard for designing culverts than the annual 10% exceedance flow, and that an ongoing study found that the higher Caltrans high flow design standard for fish passage impeded upstream passage in small watersheds (presumed depth limitation, following final report conclusions; Lang et al. 2004).

McBain and Trush (1999) noted that the upper flow window value of $0.7Q_{BF}$ was approximated by the annual 1% exceedance flow. Its ecological significance was attributed to it being the flow that will not dewater most seasonally important habitat such as scour channels, side channels of abandoned meander bends, and alcoves. In addition, it was considered the lower flow threshold for initiating bedload transport and pool scour, and for preventing riparian encroachment of the channel.

The value of Q_{AC} was also noted to result in greater minimum passage depths (MPDs) in area streams, than the Russian River Staff Report (SWRCB 1997) and NMFS proposals, and more often met MPD criteria (MTTU 2000). Their analyses reflected work eventually reported by Lang et al. (2004). The behavior of steelhead was particularly noted where males may travel up and down several watersheds many days following the peak flow that initially stimulated their upstream migration. On-channel reservoirs in watersheds smaller than 10 mi^2 that did not pass peak flows were considered to prevent upstream migration of anadromous salmonids, because the affected streams required proportionally more water to provide passage and habitat conditions suitable for spawning.

The revised TU proposal (MTTU 2000), which was built on the previous recommendations and observations and on additional analyses, consisted of the following primary actions for diversion in streams with watershed areas less than about 10 mi^2:

1. No water should be diverted below the active channel stage height, as defined by Q_{AC} rather than a specified exceedance probability, although TU did recommend that a 10% exceedance probability be initially assigned as Q_{AC} for streams with watershed areas smaller than 10 mi^2 (and possibly a lower probability for streams with basin areas smaller than about 2 mi^2);
2. Diversions should be designed to reserve a fraction of higher flows exceeding the active channel stage height, whereby the maximum diversion rate would not alter the timing of the active channel flow by more than one-half day for each high flow event;
3. Existing on-stream reservoirs must be approved or removed, on all classes of streams (I, II, and III) pending a publicly available accounting of (i) potential cumulative downstream effects on anadromous salmonid habitat, (ii) potential use of upstream habitat, (iii) other fishery and aquatic resources as defined by the DFG code, (iv) off-channel habitat and wetlands, and (v) channel maintenance processes;
4. Application for a new on-stream reservoir could be approved only after it can be demonstrated that it does not impair the hydrograph at the upstream limit of potential anadromous habitat (including above currently impassable culverts and other anthropogenic barriers) and that it sustains downstream riparian, wetland and other aquatic resources;
5. The water right review process must identify all potential downstream barriers, and evaluate the cumulative effect of the proposed or existing diversion together with all existing upstream water rights;
6. All new and existing on-stream reservoirs that intercept coarse bedload must have an approved operational plan for annually replacing the lost bedload volume downstream of the structure;
7. The State Water Board should establish a protocol for required, consistent compliance monitoring and diversion design, with random compliance audits and assessment of penalties; and
8. The State Water Board should devise and implement an effectiveness monitoring program jointly with other resource agencies, as part of an ongoing adaptive management plan; the program should include development of regional channel size, active channel discharge, and hydraulic geometry relationships, plus an inventory of all

permitted, riparian, and other diversions so that downstream cumulative impacts can be properly assessed.

The proposed DFG-NMFS (2000) Draft Guidelines and State Water Board staff recommendations (1997, 1998b) were considered less protective than the criteria outlined in bullets 1 and 2 above. McBain and Trush (2000) compared the three sets of approaches with respect to total (or, cumulative) spawnable area, minimum passage depths, and availability of spawning habitat. They noted that, in some streams, even the DFG-NMFS (2000) proposed diversion rate criterion would result in substantial reductions in available spawning habitat.

A.3.3 Moyle et al. (2000) Proposal

Moyle et al. (2000) summarized the ideas and comments generated in the January 31, 2000 workshop. However, they did not recommend a definitive method for specifying allowable diversion rates and recommending instream flows. Instead, they provided a conceptual synthesis of actions that should be taken within the context of adaptive management, and that would lead to identifying a protective set of instream flow requirements. The primary recommendation was to defer approval of any new water rights until the various sources of uncertainty affecting the status of coho and steelhead populations were understood sufficiently, so that diversions could be conditioned to avoid unacceptable risk of harm to listed species and public trust resources. In the meantime, the State Water Board was urged to follow the tenets of adaptive management if any new diversions were indeed to be permitted. In this case, Moyle et al. (2000) suggested following the initial DFG-NMFS (2000) draft guidelines with the addition of a separate minimum passage depth criterion for smaller streams used by anadromous salmonids and consideration of the effects of diversions on the duration of high flows. Specific recommended actions for implementing the initial draft guidelines included:

1. Basing instream flow and bypass standards on clearly defined objectives;
2. Using biological and hydrological criteria that can be expressed as testable hypotheses;
3. Requiring a monitoring program that tests the hypotheses; and
4. Modifying the diversion conditions accordingly.

Other recommendations included not approving on-stream impoundments on perennial streams, and only approving such reservoirs on ephemeral streams in cases where only a fill and spill approach is considered acceptable and subject to the condition that they be emptied annually to control exotic species. Lastly, the State Water Board was urged to work with other resource agencies and academic institutions to promote biological and hydrological data collection, research, and monitoring, with effort most efficiently and effectively focused on a sub-sample of sites, and to improve flow estimation capabilities.

A.3.4 August 2000 SWRCB Workshop

In August 2000, the SWRCB held a workshop on the initial DFG-NMFS (2000) draft guidelines, comments and presentations from the January 2000 workshop, and Moyle et al.'s (2000) peer review report. During the workshop, Division staff reported that the higher February median bypass flow proposed by NMFS was about twice the magnitude of the 60%Q_m recommendation in the Russian River Staff Report (SWRCB 1997), but still allowed for diversion. Thus, Division staff recommended using the February median flow instead of 60%Q_m for the minimum bypass flow (SWRCB 2000).

A.4 REVISED DFG-NMFS (2002) DRAFT GUIDELINES

The revised DFG-NMFS guidelines published in 2002 (Draft Guidelines) contained many of the same elements presented in the initial DFG-NMFS (2000) draft guidelines. Minor modifications were made that reflected comments on the Russian River Staff Report (SWRCB 1997) and initial DFG-NMFS (2000) draft guidelines made by various participants in the process, including as part of the January 31, 2000 peer review workshop. The modifications also reflected discussions and comments shared between State Water Board staff (SWRCB 2001) and NMFS (Bybee 2001) concerning appropriate ways to assess cumulative impacts. The most substantive revisions concerned protection of the natural hydrograph and cumulative flow impacts. Item 3 in Section A.3.1 above was modified to be more conservative, as follows:

- Absent compelling site-specific information and analyses demonstrating otherwise, the natural hydrograph should be protected by either:

    a. Limiting the cumulative instantaneous rate of withdrawal to 15% of the winter 20% exceedance flow during the period December 15-March 31, subject to a limiting cumulative rate of withdrawal that does not appreciably diminish (qualified as <5% of) the natural hydrograph flows needed for channel maintenance and upstream fish passage; or

    b. Limiting the total cumulative volume of water to be diverted at historical limits of anadromous fish distributions to 10% of the unimpaired runoff during the period December 15-March 31 during normal water years, using a Cumulative Flow Impairment Index (CFII); hydrologic analysis is needed for projects with CFIIs between 5%-10% that demonstrates the diversion will not cause or exacerbate significant cumulative effects to salmonid migration and spawning flows.

An appendix was provided as part of the DFG-NMFS Draft Guidelines that detailed the procedure for calculating the CFII as:

$$CFII = \frac{Cumulative\ Diverted\ Volume\ From\ 10/1-3/31}{Estimated\ Unimpaired\ Runoff\ From\ 12/15-3/31}$$

The CFII was proposed to be evaluated at various points of interest (POIs) representing the point of diversion (POD) and the confluences of major intervening tributaries between the POD and the mainstem coastal rivers or estuary, depending on overall basin size. The locations of POIs were to be determined by NMFS and DFG staff. The Cumulative Diverted Volume (CDV) would be assessed for all existing water rights expected to be exercised during the period indicated in an average water year, including pre-1914 rights, riparian rights, small domestic and stock pond registrations, and other appropriative rights, plus the proposed diversion. The Estimated Unimpaired Runoff (EUR) would be similarly calculated for an average year, using standard hydrologic techniques. The specific technique applied would be left to the discretion of the applicant and could reflect available information as opposed to requiring collection of new data.

Cases where the calculated CFII exceeds 5% and there is an appreciable impairment on the hydrograph would require a site specific study addressing geomorphic effects (including channel maintenance, sedimentation, and estuarine disconnection from the ocean), anadromous salmonid spawning habitat flow needs (in including identifying minimum bypass flow and maximum instantaneous rate of withdrawal), and upstream salmonid migration ability below the diversion site(s).

A.4.1 Technical Basis of DFG-NMFS Draft Guidelines

Much of the underlying basis of the DFG-NMFS (2002) Draft Guidelines is described above, particularly with respect to setting of the diversion season and retaining flow variability in streams with diversions and impoundments. Primary sources of information detailing the technical basis of the guidelines included State Water Board (SWRCB 1997, 2001), DFG-NMFS (2000, 2000b, 2002), and personal communications with W. Hearn (NMFS), L. Hanson (DFG), and S. Herrera (SWRCB). The major concepts and data used in developing and providing the technical justification for the DFG-NMFS (2002) Draft Guidelines are summarized as follows:

1. The setting of instream flow standards in streams where a site-specific study has not been conducted has relied typically on hydrologic metrics that can be relatively easily estimated, including for ungaged basins. Hydrologic metrics to a certain extent inherently consider stream channel size and water availability. Deferral to the findings of a subsequent instream flow study allows for adjustment from potentially conservative guidelines. The standard setting approach used should be practicably implemented and yet be conservatively protective of aquatic resources in the absence of a more detailed, site-specific study.

2. The hydrologic-based New England Aquatic Base Flow Policy (ABF) served as an initial model for the development of the Russian River basin methodology. Appropriate metrics for use in the ABF were derived from an analysis of stream gages in unregulated

New England streams. The ABF method recommends the August median daily average flow as a minimum instantaneous summer low flow requirement, and seasonal releases equal to the median February and April/May flows in the fall/winter and spring periods, respectively, to protect fish spawning and incubation life stages (IFC 2002). The underlying assumptions of this method are that (i) hydrology could be used as a surrogate for habitat, and (ii) fish species and their various life history stages are adapted to median flow levels during the respective months of importance when each life stage's survival would be most vulnerable.

3. It was recognized that providing a single flow value cannot simultaneously meet the habitat requirements for all species and life stages of fish. Rather, a range of flows is needed to facilitate physical processes controlling form and function of stream channels and biological diversity within and adjacent to the stream ecosystem (IFC 2002). A basic principle for guideline development was therefore to preserve hydrograph variability as much as possible, with a lower limit instream flow set to protect habitat during baseline flow conditions.

4. The time of year that diversion could occur should reflect water availability for multiple uses. Summer flows are typically low, and early fall and spring flows are highly variable. Most water for uses other than instream needs is available during the winter-early spring months, and hence December 15-March 31 was defined as the permissible diversion period. The specified timing also reflected regional migration and spawning periodicities of coho salmon and steelhead trout.

5. A median flow statistic was considered reasonable and practical, because it could be estimated with less bias than other percentile and average values. February was selected as the corresponding month on which the median flow criterion should be based because a review of unregulated stream gage data in the region indicated flows were highest overall during that month. Selection of the February median flow would thus be more protective for fish than median flows of other months. In addition, the gage analysis indicated that flows in January and March were not substantially lower than in February, so that specification of a February median flow criterion would not severely restrict diversion during the rest of the permissible diversion season.

6. February was also the month of peak steelhead migration to spawning grounds in small tributaries within the project area, and thus represented a critical month for anadromous fishery protection. Flows needed to protect spawning and incubation tend to be higher than flows needed to protect other life stages, such as juvenile rearing and adult holding. Provision of flows that meet spawning and incubation needs should, therefore, be protective of other life history stages. Steelhead redds constructed nearer the median February flow level should be at less risk of dewatering and stranding than redds constructed at higher flow levels. Sustained flow over the redd is important given that typical intragravel residence times in the region range between roughly 40-60 days.

7. Sudden decreases in flows should be avoided, because they can result in trapping and stranding of over-wintering juvenile salmonids.

8. Hydrograph shape preservation could be better achieved through permitting a maximum instantaneous diversion rate, rather than specifying a total diversion volume with a minimum flow rate at which diversion could begin.
9. Reviews of unregulated stream gage data from the region indicated that a maximum instantaneous diversion equal to 20% of the 20% exceedance flow from the stream should not result in substantial changes in hydrograph shape or duration over the course of the winter period. Reducing the maximum diversion to 15% of the 20% exceedance flow would be more protective of the aquatic ecosystem.
10. Cumulative effects analyses should be conducted as screening tools, so that adverse effects can be avoided before they occur, particularly when site specific studies are not conducted.
11. Professional judgment of State Water Board staff of the results of hydrograph analyses suggested that cumulative diversions resulting in CFII values exceeding 10% would be detrimental to salmonids, and that risks of impact to salmonids also existed in some cases when the CFII value ranges between 5-10% (SWRCB 2001). Comparisons of hydrographs indicated that 15% of the winter 20% exceedance flow approximated 10% of the total unimpaired runoff during the winter diversion period, an amount that was considered to not appreciably change spawning flows and the overall hydrograph from natural conditions.
12. On-stream diversions were prohibited in streams that either currently support or historically supported anadromous salmonids. This was based on problems associated with fish passage, flow regulation, the trapping of bedload and large wood, and potential creation of non-native aquatic species habitats.