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Preliminary Regulatory Concepts

Class I Watercourses and Flood Prone Areas/Channel Migration Zones

Version 12/19/08

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Preliminary Regulatory Concepts

Class I and Flood Prone Areas/CMZ

Version: 12/19/08

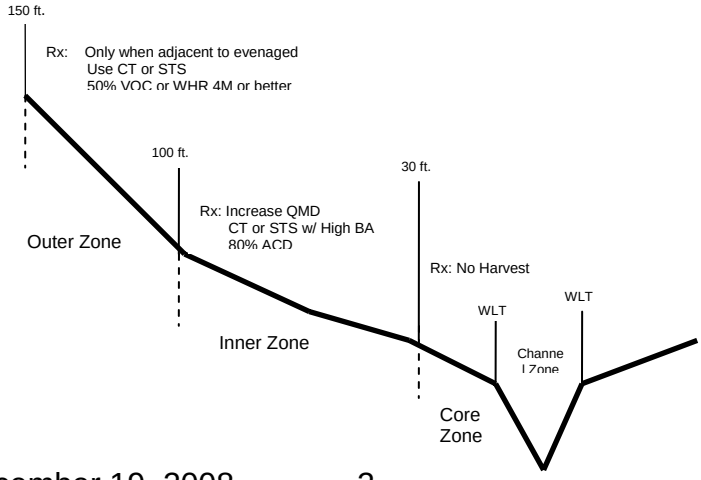
Executive Summary

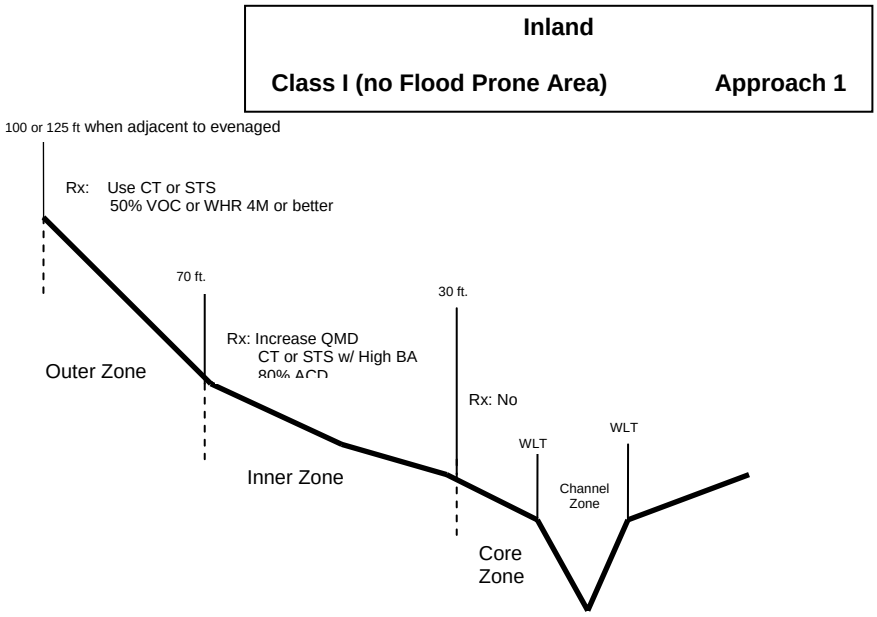
Regulatory concepts below were drafted by CAL FIRE Staff as part of the Threatened or Impaired Watersheds Rule Review conducted by the State Board of Forestry and Fire Protection. The CAL FIRE Staff has included in this document the regulatory concepts for the Class I watercourses, including those with Channel Migration Zones and/or Flood Prone Areas. The concepts resulted in WLPZ (riparian buffers) specifications for buffer length and width, tree/vegetation compositions, operational limitations, shade (and shade measurement), and regional differences. The Board will consider these concepts during its monthly Forest Practice Committee meetings, and advise staff of the preferred concepts that should be developed into a regulatory proposal.

The regulatory concepts are based on differing rules adapted for **two bio-regional settings**--coast and interior. The Interior bioregions are delineated using the Northern and Southern Forest Practice Districts. There are **three approaches** for each region for determining appropriate Class I WLPZs (riparian buffer strips): Approach 1 is for confined channels, Approach 2 is for flood prone area settings, and Approach 3 provides for a site-specific buffer design for flood prone areas. For Approach 2 (locations with flood prone areas) the Board should choose either Option 1 (no harvesting in the flood prone areas), or Option 2 (harvesting in the flood prone areas with Best Management Practices). WLPZ standards for each approach are illustrated below:

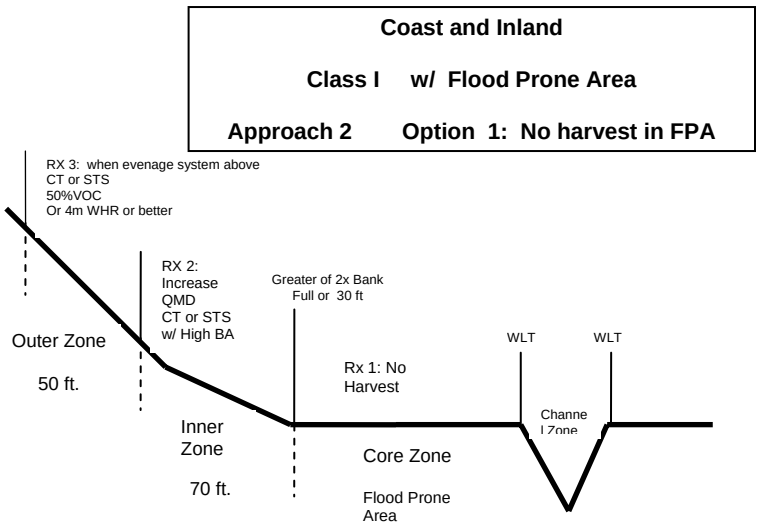
Approach (1) Prescriptive Requirements for Watercourses without CMZs/Flood Prone Areas (FPA) .

Coast District	
Class I (no FPA)	**Approach 1**





Approach (2) Option 1: Prescriptive Requirements for Watercourses with CMZs/Flood Prone Areas (FPA) with no harvesting in FPA or CMZ.



Approach (2) Option 2: Prescriptive Requirements for Watercourses with CMZs/Flood Prone Areas with harvesting.

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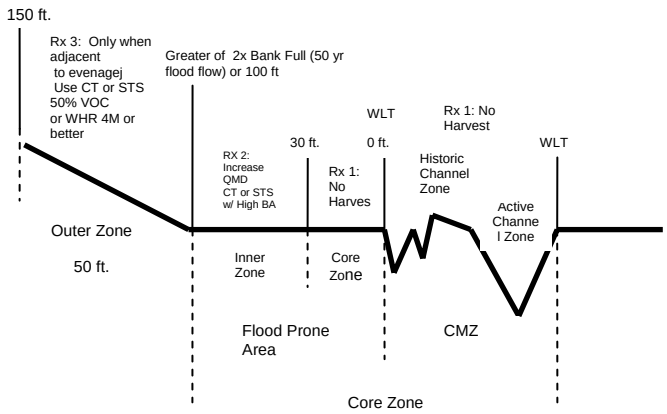
Coast and Inland

Class I with Flood Prone Area and CMZ

Approach 2 Option 2: Harvesting in FPA



Approach (3) Site Specific Design for Flood Prone Areas: Timber harvesting proposed on a flood prone areas that are not subject to prescriptive approaches above and are based on a site-specific plan.

Introduction

The Threatened or Impaired Watershed (T/I) rule review process (established by the Board's Forest Practice Committee (FPC)) includes reviewing current science, evaluating existing regulations, and developing potential amendments based on current science. With the completion of the SWC Literature Review, along with science information brought forward by agencies and stakeholders, current science information now is being considered as part of the T/I rule update.

The Board's FPC has designated a CAL FIRE staff group to use the current science and create regulatory concepts for the FPC. The CAL FIRE staff will:

1. Evaluate science relevant for each regulatory topic. Priority science includes SWC Report, but can include other peer reviewed information.
2. Consult with appropriate individuals for advice in developing supporting science, legal basis and regulatory concepts.
3. Receive and consider science and regulatory proposals from stakeholders and agencies. Preferential consideration is to be given to proposals which provide science justifications.
4. Develop regulation concept or specific regulatory language based on its science considerations and all information received. Alternative regulatory concepts may be prepared.
5. Compare prepared regulatory concepts to existing T/I Rules and other FPRs.

The CAL FIRE Staff will review the regulatory topics in the following order, with some being done simultaneously:

1. Class I watercourses
2. Channel zones/Flood Prone Areas
3. Class II watercourses
4. Class III watercourses
5. Other "biological hotspots"
6. Inner gorges and headwalls
7. Road crossings
8. Geographic scope
9. Site specific/spatially variable approaches
10. Opportunities of voluntary restoration, specifically LWD placement in streams, as part of the THP process.

The CAL FIRE staff has included in this document the regulatory concepts for Class I watercourses, including those with Channel Migration Zones and/or Flood Prone Areas. The science considerations have resulted in specifications for buffer length and width, tree/vegetation compositions, operational limitations, shade (and shade measurement), and regional differences.

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DETAILED CLASS I WATERCOURSE CONCEPTS

Preliminary Science-Based Concepts for Revised Class I T/I Rules--NOT RULE LANGUAGE (changes following FPC discussions on December 1-2, 2008)

Use at least **Two Bio-Regions** with differing rules—Coast and Interior (Northern and Southern Districts) [*note problem regarding the Klamath Province—consider establishment of a Northern Interior Bio-Region*]

Three Main Approaches for determining appropriate riparian buffer strips—(1) **Modified Minimum Prescriptive Requirements for Confined Watercourses without Flood Prone Areas** (to be found under 916.9[1], (2) **Modified Prescriptive Minimum Requirements for Unconfined Watercourses with Flood Prone Areas (2 options)**, and (3) **Site-Specific Plans for Unconfined Watercourses with Flood Prone Areas**.

Class I Watercourse Size Categories

Option 1: [preferred]
Make no distinction for different size Class I watercourses. [addressed with flood prone area requirements]

Option 2: [important consideration—not to be used at this time for rule revisions]
Divide Class I Watercourses into 3 subcategories based on bankfull stream width (i.e., channel width at bankfull discharge).[2]

Small Class I (<32 ft or 10 m)[3]
Medium Class I (32 ft to 100 ft)
Large Class I (>100 ft or 30 m)[4]

Watercourse Transition Line and Channel Migration Zone Definitions

[Denoting where the WLPZ begins and the edge of the channel zone, where harvesting is prohibited, with exceptions in 916.9(e)]:

Option 1:. For both confined and unconfined channels, the line that is defined by the bankfull edge of the channel. Bankfull width is the measurement of the lateral extent of the water surface elevation perpendicular to the channel at bankfull stage (defined in 895.1), and typically

[1] Note that the minimum prescriptive standards are to be expanded where appropriate (e.g., where there are unstable landforms adjacent to the channel).
[2] Several studies support the concept of having the width of the Class I WLPZ zone depend on the size of the stream. For example, Bisson et al. 1987 and Bilby and Ward 1989 state that the size of large wood required by a channel varies with stream size. Additionally, the relative importance of riparian vegetation to influence stream temperature is known to vary by stream width (SWC 2008). Note that differing prescriptions for options 1 and 2 have yet to be developed.
[3] MacDonald and Coe (2007) suggest 10 m (33 ft) as a distinction between headwater streams and non-headwater streams.
[4] 32 m is the bankfull width at which canopy is estimated to become too wide for riparian vegetation to effectively shade streams (Lewis et al. 2000).

corresponds with the start of the floodplain.[5] Bankfull indicators may include: 1) a berm or other break in slope from the channel bank to a flat valley bottom, terrace, or bench; 2) a change in vegetation from bare surfaces or annual water-tolerant species to perennial water-tolerant or upland species; and 3) a change in the size distribution of surface sediments (e.g., a surface transitioning from gravel to sand)[6] [see Figure 1]

Option 2: For both confined and unconfined channels, the line that is defined by bankfull width, which can be estimated by the location of large permanent vegetation (i.e., riverine hardwood and conifer trees at least 25 years in age at breast height).

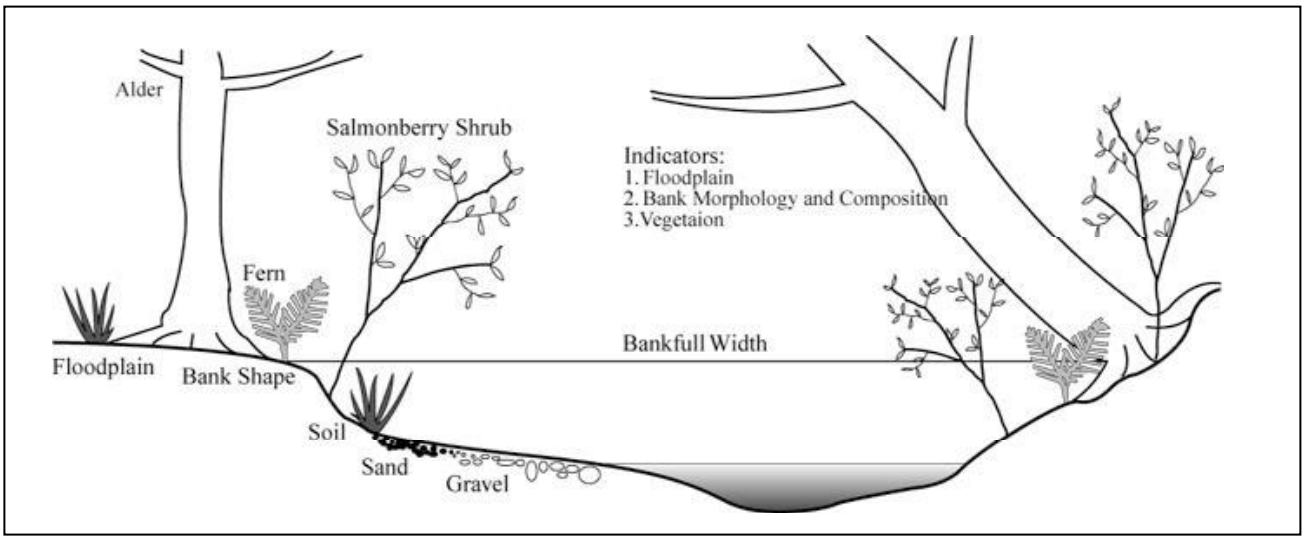

Figure 1. Indicators for determining bankfull width (*Figure 1 from WFPB 2004*).

Channel Migration Zone (CMZ) Definition

The area where the active channel of a stream is prone to move through avulsion and lateral erosion, resulting in a potential near-term loss of riparian function and associated habitat adjacent to the stream, except as modified by a permanent levee or dike. For this purpose, near-term

[5] Note that the RPC Report (Cafferata et al. 2005) recommended not having separate definitions for confined and unconfined channels, since the existing definitions have led to confusion and proven difficult to use in the field. Bankfull width definition is from the WFPB (2004) document titled "Standard Methods for Identifying Bankfull Channel Features and Channel Migration Zones." The WFPB FPRs begin a Riparian Management Zone at the outer edge of the bankfull width if a CMZ is not present.

[6] Note that the RPC Report (Cafferata et al. 2005) recommended not having separate definitions for confined and unconfined channels, since the existing definitions have led to confusion and proven difficult to use in the field. Bankfull width definition is from the WFPB (2004) document titled "Standard Methods for Identifying Bankfull Channel Features and Channel Migration Zones." The WFPB FPRs begin a Riparian Management Zone at the outer edge of the bankfull width if a CMZ is not present.

means the time scale required to grow forest trees to a mature size (approximately 80 years).[7] [see Figure 2]

Flood Prone Area

A generally flat landscape feature immediately adjacent to most stream and river channels that begins at the edge of the bankfull channel and receives overbank flow. This area is defined as the elevation equivalent to twice the maximum depth of the adjacent riffle at bankfull stage.

The Class I WLPZ width is to be measured as slope distance from the Watercourse Transition Line (WTL) on each side of the watercourse.

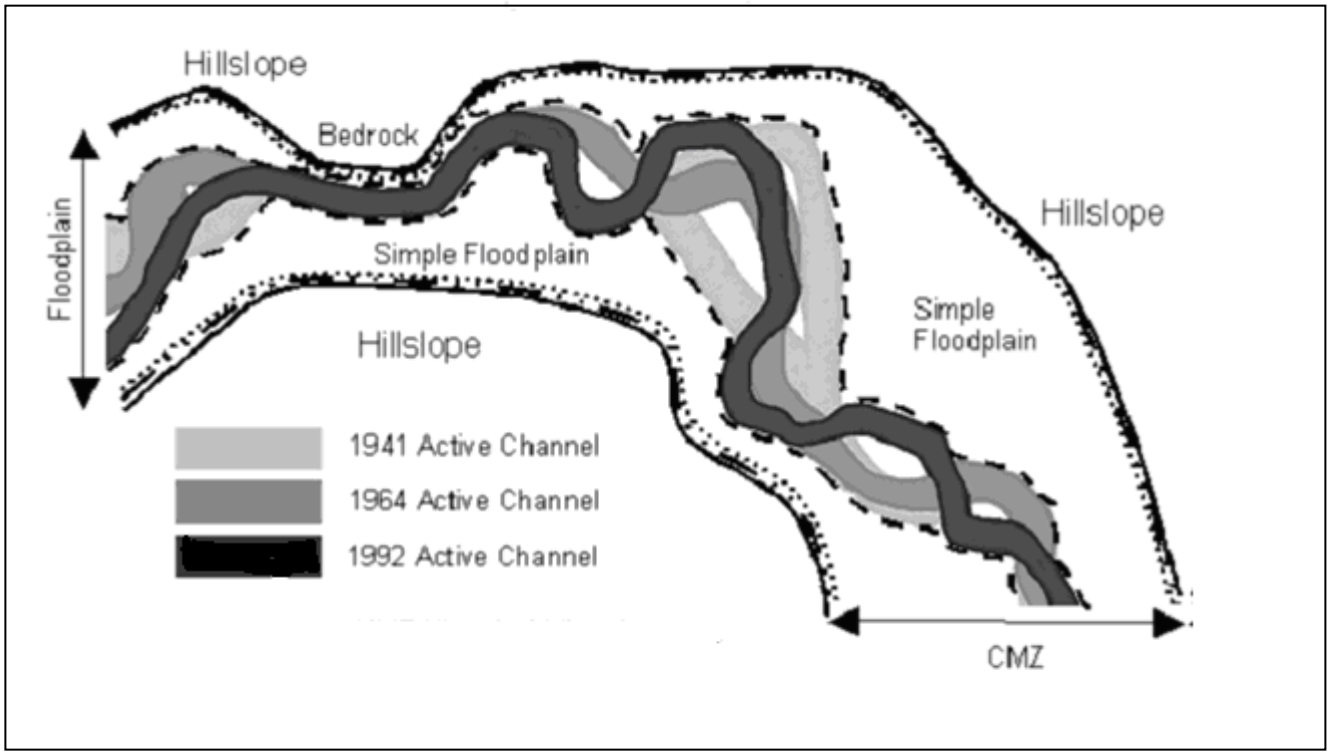

Figure 2. Plan view diagram of a simple flood prone areas that abuts valley walls illustrating CMZ designation (*Figure 20 from WFPB 2004).* Note this diagram differs from the proposed reg. concept definitions of flood prone area and CMZ and is used here only for demonstration purposes.

Fully Functioning Salmonid Habitat

[definition to be provided]

[7] This definition is adapted from WFPB 2004 and the RPC Report. Determination of the CMZ can be conducted by RPFs that are trained regarding riparian landforms and channel morphology and may require a Professional Geologist's field review. WFPB (2004) provides considerable guidance on CMZ determination. CMZs provide extremely valuable habitat for anadromous fish.

Coast Region (Coast District) [Approaches Summarized in Table 1]

Approach #1: Modified Prescriptive Minimum Requirements for Confined Watercourses without Flood Prone Areas (i.e., the width of the valley floor is approximately equal to bankfull channel width)

WLPZ width—Class I 100-150 ft (slope distance), depending on silvicultural system applied adjacent to the WLPZ[8]

Establish three zones: The core zone is nearest to the water, the inner zone is the middle zone, and the outer zone is furthest from the water.[9]

Class I:

Core zone: 0-30 ft **Streamside Bank Protection Zone without harvesting** to promote bank stability,[10] wood recruitment by bank erosion, and canopy retention, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). ***In lieu practices*** such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. may be proposed where: (1) it can be demonstrated that adequate bank stability, shading, and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).[11]

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[8] The suggested WLPZ width of 100 to 150 feet is derived from several sources. Belt et al. (1992) state that a maximum protection approach is to evaluate each of riparian function criteria in terms of buffer strip width, and then adopt the greatest width so as to accommodate all criteria. Benda et al. (2003) state that recruitment patterns of wood can be used to design buffer strip dimensions. Many studies support the contention that the wood recruitment subsumes other riparian processes (except for sediment from roads) in terms of zone width (Benda 2008a, 2008b), and that most large wood is recruited from within 20 m (66 ft) to 40 m (130 ft) of channel banks [note that wood recruitment source-distance curves are highly related to input process (Naiman et al. 2000, Benda et al. 2003, Benda and Associates 2004)]. Spence et al. (1996) state that a protected buffer of approximately 30-45 m (approximately one site potential tree in most PNW forests) provides 90 to 100% of inputs from a fully functioning riparian corridor (and that buffer widths of approximately 0.75 site-potential tree heights are needed to provide full protection of stream shading, litter inputs, and nutrient regulation). Benda's (2008) buffer design strategy for large wood recruitment figure displays the outer mortality zone as extending to 150 ft.

[9] Benda's (2005) management strategy No. 1 for large wood recruitment presented to RPFs at a 2005 CLFA workshop and during the TEF on October 23rd (Benda 2008a) supports the use of three zones.

[10] Benda (2008a) reported that bank erosion is the principle source of "key pieces" of large wood, and that selective harvest can threaten that source. Benda's (2005) diagram shows that, on average, 70% of cumulative wood recruitment comes from the first 10 m (33 ft). This approach is also supported by the CH2M-Hill and Western Watershed Associates (1999) review of root strength. Their review reported that root strength protecting stream channels comes from a distance equal to ½ mature tree crown diameter (stated as ~30 ft or less for coast redwood in the RPC Report). The RPC Report states that if no harvesting is proposed in this zone, it is possible to conclude that little if any change in bank stability would be anticipated (particularly for a laterally stable channel network).

[11] SWC (2008) found that mechanical disturbance from management activities within about 30 feet will often produce and deliver sediment to stream channels. Note that this does not include

Inner zone: 30-100 ft **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input.[12] Limited to entry using the following silvicultural systems: thinning from below[13], commercial thinning, or single tree selection. Quadratic mean diameter (QMD) of the stand must increase after harvest for all silvicultural systems used. If the commercial thinning or single tree selection methods are used, there must be a basal area retention of xxx sq ft/ac. Salvage logging is limited to current requirements in 916.9 (s), (t), and (u). All trees leaning towards the channel must be retained.

Core Zone plus Inner Zone:
Retain 80% ACD shading (not vertical overstory canopy cover). [14] Retain 10 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range. Option A: Smaller, leaning trees most likely to fall towards the stream nearer the channel can be proposed for trading where

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sediment in concentrated flow that is routed through riparian protection zones in gullies or small channels.

[12] SWC (2008) stated that to facilitate long-term recruitment of large wood loading in streams, management should encourage the development and retention of large trees in the near stream riparian zone. The 30 to 100 ft high basal area and canopy retention zone is supported by Benda's (2008) TEF presentation and Benda's (2005) buffer design strategy for large wood recruitment figure. Benda's TEF diagram for the coast region for old forests shows slightly more than 90% cumulative effectiveness for wood recruitment coming from the first 100 feet. Benda (2008b) states that 100% wood recruitment would require a zone of 170 ft.

[13] Source distance relationships for riparian functions support the concept of near-stream silvicultural prescriptions being driven by factors which emphasize retention and/or recruitment of large trees to facilitate riparian functions (SWC 2008, Pyles et al. 2002). The RPC Report stated that thinning from below involves harvesting intermediates and co-dominants only, and that quadratic mean diameter (QMD) of the stand must increase after harvest. Modeling showed that this silvicultural method did not significantly reduce the number of large trees following six decades. The SRP Report (Ligon et al. 1999) thinning from below definition was stated as: "A low thinning is to be used in conjunction with silvicultural treatments in Zone A of Class I WLPZs. This thinning involves the removal of the understory, mid-canopy, and very limited numbers of co-dominant trees. Co-dominant trees may be removed only to improve spacing and enhance growth. Dominant trees may not be removed, and average stand diameter must increase following harvest." QMD is defined as the average diameter corresponding to the mean basal area. Spence et al. (1996) state that for second-growth forests, limited harvest, thinning, planting, or other manipulations may be appropriate in order to facilitate recovery and protection of key functions, particularly in coastal forests. They report that these activities should only be allowed when they can be performed without adversely impacting other riparian functions or values. Spence et al. (1996) state that the overall goal should be to restore the riparian zone to a "natural" condition, not to maintain timber production within the riparian zone over the long term.

[14] Angular canopy density (ACD) is the percentage of time that a given point on a stream will be shaded between 10 a.m. to 2 p.m. local solar time in mid to late-summer. The importance of a buffer strip for preventing increases in stream temperature can be determined by measuring ACD (Beschta et al. 1987, OFPAC 1999). ACD of old growth stands in western Oregon have been reported as between 80 and 90% (Brazier and Brown 1973, Steinblums et al. 1984). Erman et al. (1977) reported ACD in northern California as averaging 75% along undisturbed streams. Steinblums (1977) measured ACD for Oregon buffer strips and reported that a buffer strip 85 ft wide shades a stream as well as an average undisturbed forest canopy. ACD can be measured with a Solar Pathfinder, preferably along the twalweg of the watercourse channel (Dr. Cajun James, SPI, Anderson, CA, personal communication). Both conifers and hardwoods are to be used for ACD measurement.

appropriate.[15] Option B: Retain the 10 largest trees most likely to fall towards the stream (most conducive to recruitment).

Outer zone: 100-150 ft **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater.[16] Retain at least 25% of the residual overstory canopy from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the WLPZ, the outer zone requirement is waived. [***In lieu practices*** *may* be proposed]

[15] B. Valentine, DFG, stated in the CDF (1997) coho salmon considerations white paper that Lienkaemper and Swanson (1987, as cited in Cummins 1994) suggest that approximately 10 mature conifer trees per 100 m of stream are needed to achieve debris loading similar to that in a mature forest stream system. Pyles et al. (2002) state that a 28 inch tree near the stream with a high potential to fall into it may be more important to save than a larger 32 inch tree up the slope with much less potential to reach the stream, suggesting that trading trees is appropriate.

[16] The outer zone is primarily for wind resistance for buffering the buffer (Mitchell 1998, Kelsey and West 2001), wood recruitment from the outer mortality zone (Benda 2008a), micro-climate control for purposes other than limiting water temperature change (Brosofske et al. 1997, Pyles et al. 2002), and providing habitat for wildlife species (Kelsey and West 2001). There are conflicting opinions in the literature regarding the value of buffering the buffer strip along a stream channel to reduce windthrow. Steinblumes (1977) reported that topography and uncut timber stand protection are the most important factors modifying the amount of windthrow in Oregon buffer strips. The distance from the outer edge of the buffer strip to the cutting line in the direction of damaging winds was the most important variable influencing buffer strip survival, with increasing distances leading to poorer survival. Steinblumes et al. (1984), Ruel et al. (2001) and Drake 2008, however, did not find a significant relationship between buffer strip width and tree stability related to windthrow, and the latter two studies did not find a relationship between buffer thinning and windthrow. Kelsey and West (2001) state that as the probability of windthrow increases, greater protection for riparian trees is needed. They say that this can be accomplished by increasing the width of buffer strips and establishing areas of selective harvest along the buffer, and by gradually decreasing density of trees through selective cutting, the landowner derives economic benefits while at the same time protecting the riparian corridor. Drake (2008), however, did not observe a difference in windthrow with varying thinning treatments of neighboring stands. Drake (2008) states that the effectiveness of the neighboring forest's ability to shelter the buffer strip likely depends to a large extent on the residual thinning density, age, species present, and height of the stand. Rhodes et al. (1994, as cited in Spence et al. 1996) suggest that buffers need to extend to a distance of two site-potential tree heights (or > 91 m) to protect riparian buffers from windthrow. Windthrow is likely a larger issue for coastal California buffer strips than for interior areas of the state (see for example, Surfleet and Ziemer 1996). SWC (2008) reported that micro-climate changes have not been demonstrated to translate to changes in water temperature. Pyles et al. (2002) suggest retaining 50% overstory canopy in the outer 100-150 ft band of a Class I coast riparian management zone for amphibian habitat and to enhance the water temperature control provided by the inner band. Belt et al. (1992) reported that variable width buffer strips have the potential to improve stream protection benefits. WHR class 4M denotes forested habitat with a quadratic mean diameter from 11-24 inches and canopy closure from 40-60 percent; 5M denotes forested habitat with a quadratic mean diameter greater than 24 inches and canopy closure from 40-60 percent.

Approach #2: Modified Prescriptive Minimum Requirements for Unconfined Watercourses with Flood Prone Areas

Option 1 (Prescriptive no-harvest for flood prone areas)

Channel Migration Zone (if present): No timber harvesting operations are permitted within channel migration zones except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). Channel migration zones tend to be more common where the valley floor is more than four (4) times the width of the bankfull channel. [17]

Core zone: The area encompassing the flood prone area, but not less than 30 feet.[18] No timber harvesting operations or salvage is permitted, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). The flood prone area is defined as the elevation equivalent to two times bankfull stage depth (see Figure 3).[19] ***In lieu practices*** may be allowed, such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. where: (1) it can be demonstrated that adequate bank stability and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).

Inner zone: Landward edge of flood prone (two times bankfull stage) area plus 70 feet. **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input. Limited to entry using the following silvicultural systems: thinning from below[20], commercial

[17] WFPB (2004) defines an approach for delineating CMZs and protecting valuable off-channel habitats.

[18] SWC (2008) found that protection/enhancement of biological "hot spots" such as flood prone areas should be a priority.

[19] Dunne and Leopold (1978, pg 647-648) provide data for discharges of a given recurrence interval in relation to elevation of the water surface for various regions of the U.S. Rosgen (1996) states that: "To measure the width of the flood prone area, select the elevation that corresponds to twice the maximum bankfull channel depth as determined by the vertical distance between bankfull stage and the thalweg of a riffle. Field observations show that for most stream types, this elevation is associated with a <50 year return period flood, rather than with a very rare flood." For the California Coast Ranges, two times bankfull stage depth, measured from the twalweg riffle crest (illustrated in Lisle 1987), equates to approximately the 40-50 year return period flood event (i.e., the depth determined with this method inundates the 20 yr floodplain but does not stop at that elevation, and tends to preserve the riparian corridor) (Dr. William Trush, McBain and Trush, Arcata, CA, personal communication).

[20] Source distance relationships for riparian functions support the concept of near-stream silvicultural prescriptions being driven by factors which emphasize retention and/or recruitment of large trees to facilitate riparian functions (SWC 2008, Pyles et al. 2002). The RPC Report stated that thinning from below involves harvesting intermediates and co-dominants only, and that quadratic mean diameter (QMD) of the stand must increase after harvest. Modeling showed that this silvicultural method did not significantly reduce the number of large trees following six decades. The SRP Report (Ligon et al. 1999) thinning from below definition was stated as: "A low thinning is to be used in conjunction with silvicultural treatments in Zone A of Class I WLPZs. This thinning involves the removal of the understory, mid-canopy, and very limited numbers of co-dominant

thinning, or single tree selection. Quadratic mean diameter (QMD) of the stand must increase after harvest for all silvicultural systems. If the commercial thinning or single tree selection methods are used, there must be a basal area retention of xxx sq ft/ac. Salvage logging is limited to current requirements in 916.9 (s),(t), and (u). All trees leaning towards the channel shall be retained. ***In lieu practices*** may be proposed.

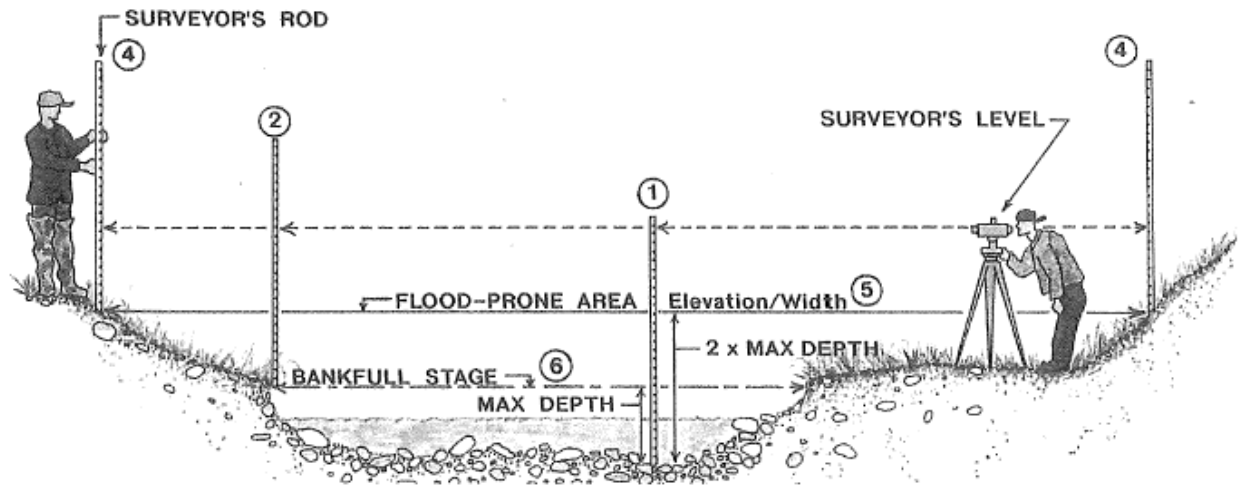

Figure 3. Illustration for determining a flood prone area using the two times bankfull stage method (*Figure 5.11 from Rosgen 1996).*

Core Zone plus Inner Zone:
Retain 80% ACD shading (not vertical overstory canopy cover). The 10 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range shall be retained. Option A: Smaller, leaning most likely to fall towards the stream nearer the channel can be proposed for trading where appropriate. Option B: Retain the 10 largest trees most likely to fall towards the stream (most conducive to recruitment).

Outer zone: Landward edge of inner zone plus 50 feet (total WLPZ width is a minimum of 150 feet where evenaged silviculture is proposed above the WLPZ, but may be considerably wider with significant flood prone area). **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater. Retain at least 25% of the residual overstory canopy

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trees. Co-dominant trees may be removed only to improve spacing and enhance growth. Dominant trees may not be removed, and average stand diameter must increase following harvest." QMD is defined as the average diameter corresponding to the mean basal area. Spence et al. (1996) state that for second-growth forests, limited harvest, thinning, planting, or other manipulations may be appropriate in order to facilitate recovery and protection of key functions, particularly in coastal forests. They report that these activities should only be allowed when they can be performed without adversely impacting other riparian functions or values. Spence et al. (1996) state that the overall goal should be to restore the riparian zone to a "natural" condition, not to maintain timber production within the riparian zone over the long term.

from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the WLPZ, the outer zone requirement is waived. ***In lieu practices*** may be proposed.

Option 2 (Flood Prone Area BMP Option)

Channel Migration Zone (if present): No timber harvesting operations are permitted within channel migration zones except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). Channel migration zones tend to be more common where the valley floor is more than four (4) times the width of the bankfull channel.

Core zone: 0-30 ft **Streamside Bank Protection Zone.** No timber harvesting operations or salvage is permitted, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). ***In lieu practices*** such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. can be proposed where: (1) it can be demonstrated that adequate bank stability and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).

Inner zone: 30 ft to the edge of flood prone area (two times bankfull stage), or 100 feet (whichever is greater). **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input. Limited to entry using the following silvicultural systems: thinning from below[21], commercial thinning, or single tree selection. Quadratic mean diameter (QMD) of the stand must increase after harvest for all silvicultural systems. If the commercial thinning or single tree selection methods are used, basal area retention of xxx sq ft/ac. is required. Salvage logging is limited to current requirements in 916.9 (s),(t), and (u). All trees leaning towards the

[21] Source distance relationships for riparian functions support the concept of near-stream silvicultural prescriptions being driven by factors which emphasize retention and/or recruitment of large trees to facilitate riparian functions (SWC 2008, Pyles et al. 2002). The RPC Report stated that thinning from below involves harvesting intermediates and co-dominants only, and that quadratic mean diameter (QMD) of the stand must increase after harvest. Modeling showed that this silvicultural method did not significantly reduce the number of large trees following six decades. The SRP Report (Ligon et al. 1999) thinning from below definition was stated as: “A low thinning is to be used in conjunction with silvicultural treatments in Zone A of Class I WLPZs. This thinning involves the removal of the understory, mid-canopy, and very limited numbers of co-dominant trees. Co-dominant trees may be removed only to improve spacing and enhance growth. Dominant trees may not be removed, and average stand diameter must increase following harvest.” QMD is defined as the average diameter corresponding to the mean basal area. Spence et al. (1996) state that for second-growth forests, limited harvest, thinning, planting, or other manipulations may be appropriate in order to facilitate recovery and protection of key functions, particularly in coastal forests. They report that these activities should only be allowed when they can be performed without adversely impacting other riparian functions or values. Spence et al. (1996) state that the overall goal should be to restore the riparian zone to a "natural" condition, not to maintain timber production within the riparian zone over the long term.

channel shall be retained. ***In lieu practices*** may be proposed. Harvesting will be subject to a set of Best Management Practices listed below.
BMPs for the Inner Zone on Flood Prone Areas Include:

1. No tractor skidding over, through, or along secondary channels (protection of overflow channels is key element).
2. Very limited, pre-flagged, pre-approved skid trails designed and laid out, used, maintained and abandoned so as to minimize risk of becoming new secondary channels by flood flows.
3. No harvest of any tree likely to recruit directly to the active channel (i.e., leaning conifer trees)
4. Treatment of any ground disturbance greater than 100 square feet.
5. Operations conducted only in dry soil conditions.
6. Zero levels of turbid runoff.
7. All roads and landings located outside of zone (already required by 916.3(c)).
8. Retain existing hardwoods and down LWD.
9. Implement maintenance and repair actions that contribute to improving undesired existing conditions and contribute to restoring fully functioning habitat.
10. To the greatest extent possible, apply 916.4(d): no heavy equipment in WLPZ, unless approved by affected agencies.
11. Roads, skid trails, yarding corridors, falling activities, and logging dragging, should not alter the natural drainage or flow patterns.
12. Ground disturbing activity associated with operations on flood prone areas should avoid depressions that have potential of becoming flow relief ditches.
13. No site preparation.
14. Logging slash shall be generally removed from flood prone areas and slash disposal in side channels avoid. When slash is retained within the flood prone areas, scatter slash and avoid piling or other concentrations.
15. No servicing of equipment within the flood prone area.
16. Locations of all WLPZ zones and CMZs shall be designated on the ground.
17. Water drafting sites shall be located outside flood prone areas if possible (exceptions could include, but are not limited to, drafting from an existing watercourse crossing that is appropriately engineered to facilitate fully functioning habitat).
18. Avoid disturbance of vegetation and soils on flood prone areas that could increase the likelihood of erosion during flooding by limiting soil disturbing activities and by restoring any tracks or trails to an original surface.
19. Avoid disturbance of abandoned meanders, oxbox lakes, or other features that provide off-channel habitat for fish during flood flows.
20. Avoid activites that could increase potential for diversion or avulsion of stream flow out of existing channel, including breaching or lowering the elevation of natural levees.
21. Avoid damage to vegetation that provides a soil-reinforcing root network on the channel banks, including any secondary overflow channel.
22. Retain hydraulic roughness provided by trees on the floodplain surface, thereby slowing flood water velocity on floodplains, attenuating peak flood flows, and allow sediment to be deposited.

Core Zone plus Inner Zone:
Retain 80% ACD shading (not vertical overstory canopy cover). The 10 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range shall be retained. Option A: Smaller, leaning trees nearer the channel can be proposed for trading where appropriate.

Option B: Retain the 10 largest trees most likely to fall towards the stream (most conducive to recruitment).
Outer zone: Landward edge of inner zone plus 50 feet (total WLPZ width is a minimum of 150 feet where evenaged silviculture is proposed above the WLPZ, but may be considerably wider with significant flood prone areas). **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater. Retain at least 25% of the residual overstory canopy from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the flood prone area, the outer zone requirement is waived. Exceptions for ***in lieu practices*** may be proposed.

Approach #3: Site-Specific Plans for Unconfined Watercourses with Flood Prone Areas
(based on field information and modeling)

Timber harvesting operations may be proposed for flood prone areas beyond the outer margin of a Chanel Migration Zone based upon site specific assessments that include:,

1. Identifying the issues that need to be considered for watercourse and riparian protections [refer to Table 1 of *Flood Prone Area Considerations in the Coast Redwood Zone* (Cafferata et al. 2005)]
2. Describing processes that need to be considered for the issues identified above.
3. Developing a method to define a desired trajectory for watercourse and riparian conditions in the context of the entire watershed.
4. Defining how the proposed operations will aid reaching the desired trajectories.
5. Disclosing assumptions being made at each step and limits to both the science and the proposed management activities.
6. Identifying how to determine what needs to be monitored and how to conduct the monitoring.

The site-specific plan for Class I flood prone area management shall include an: (1) inventory of the flood prone area for all hydrologic, geomorphic, and biological functions present that can be affected by timber operations; (2) a determination of the category of inundation (as presented it the Riparian Protection committee Report, 2005) where management is proposed; and (3) an appropriate analysis for functions present in light of possible significant adverse impacts from management.

Disclosure and analysis requirements increase with increased risk associated with the proposed level of activity and the increased frequency of inundation in the flood prone area.[22]

The site-specific plan for Class I riparian management must: (1) receive concurrence from the Review Team agencies, including DFG, and (2) include a monitoring component.

[more detailed guidelines are to be developed]

[22] Language from the RPC Report (Cafferata et al. 2005). The RPC Report provides detailed information on how to conduct a flood prone area analysis.

Table 1. Summary of Class I watercourse channel categories and proposed protection approaches.[23]

Description	Valley Confinement[24]	Delineation	Protection Measures
Channel Migration Zone	Unconfined channel. The width of the valley floor is often greater than 4X bankfull channel width	RPFs that are trained regarding riparian landforms and channel morphology (note--may require Professional Geologist input)	Approach 2--no harvest in CMZ, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D)
Flood prone areas with laterally stable channel	Unconfined channel. The width of the valley floor is often 1-4X bankfull channel width	Calculated from hydrologic data. May be approximated as two times bankfull stage depth (includes the 20 year flood prone area, but delineates the 40-50 year flood prone area elevation for California's North Coast Region)	Approach 2 (option 1--no harvest in 20+-year flood prone area [core zone] and WLPZ in outer zone; option 2—BMP prescriptive approach; or Approach 3--site specific plan protecting secondary channels
Channel without CMZ or flood prone areas	Confined channel. The width of the valley floor is approx. equal to bankfull channel width	Bankfull width channel (~WTL)	Approach 1 (prescriptive WLPZ), with possible in lieu exceptions and/or general alternatives as per the FPRs

[23] Confinement classes and floodplain widths are slightly modified from WFPB 2004 and Bisson et al. 2006.
[24] Valley confinement is included here for general guidance and is not to be considered limiting.

Interior Region (Northern and Southern Districts—applicable for Sierra Nevada, Cascade Range, and Modoc Province—not Klamath Province)[25]

Approach #1: Modified Prescriptive Minimum Requirements for Watercourses without CMZs/Flood Prone Areas

WLPZ width—Class I 100-125 ft (slope distance), depending on silvicultural system applied adjacent to the WLPZ[26]

Establish three zones: The core zone is nearest to the water, the inner zone is the middle zone, and the outer zone is furthest from the water.

Class I:

Core zone: 0-30 ft **Streamside Bank Protection Zone without harvesting** to promote bank stability, wood recruitment by bank erosion,[27] and canopy retention, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). ***In lieu practices*** such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. may be proposed where: (1) it can be demonstrated that adequate bank stability and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).

Inner zone: 30-70 ft **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input. [28] Limited to entry using the following silvicultural systems: thinning from below[29], commercial thinning, or single tree selection. Quadratic mean diameter

[25] Benda (2008b) states that the importance of streamside landsliding and debris flows on wood recruitment is greater in the Klamath Mountains than in the Sierra Nevada and Cascades.

[26] A WLPZ of 100 to 125 feet for Class I interior watercourses is based on data from Benda (2003), James (2003), and Rambo and North (2008) showing that wood recruitment distance, shading requirements, and microclimate impacts are generally lower for small interior watercourse channels with listed anadromous fish species compared to coastal channels.

[27] Benda's (2005) diagram shows that, on average, 70% of cumulative wood recruitment comes from the first 10 m (33 ft).

[28] SWC (2008) concluded that there are only limited data available for the relative source distance relationships appropriate for the various geomorphic regions of California, but the most data exists for large wood. Benda (2003) reported that for the interior sites he inventoried (Lassen, Weaverville area, Judd Creek [Southern Exposure], Bailey Creek, Millseat, etc.), 90% of wood recruitment came the first 60 feet from the stream. Benda's (2008a) TEF wood recruitment diagram shows that 90% of cumulative wood recruitment for old Sierra and mature Klamath forests comes from approximately 70 ft. Benda et al. (2003) report that 90% of conifer wood from the Klamath Province and Cascade Range comes from approximately the first 70 ft (20 m).

[29] Source distance relationships for riparian functions support the concept of near-stream silvicultural prescriptions being driven by factors which emphasize retention and/or recruitment of large trees to facilitate riparian functions (SWC 2008, Pyles et al. 2002). The RPC Report stated that thinning from below involves harvesting intermediates and co-dominants only, and that

(QMD) of the stand must increase after harvest for all silvicultural systems used. If the commercial thinning or single tree selection methods are used, there must be a basal area retention of xxx sq ft/ac. Salvage logging is limited to current requirements in 916.9 (s),(t), and (u). All trees leaning towards the channel must be retained. [consider stating that prescribed conditions shall be met along 80% of the linear length of the watercourse, allowing 20% to deviate for conifer regeneration, hardwood component, etc.[30]]

Core Zone plus Inner Zone:
Retain 75 (or 80)% ACD shading (not vertical overstory canopy cover). [31] Retain 5 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range. Option A: Smaller, leaning trees nearer the channel can be proposed for trading where appropriate. [32] Option B: Retain the 10 largest trees most likely to fall towards the stream (most conducive to recruitment).

Outer zone: 70-125 ft **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater. Retain at least 25% of the residual overstory canopy from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the WLPZ, the outer zone requirement is from 70-100 ft. [***In lieu practices*** may be proposed]

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quadratic mean diameter (QMD) of the stand must increase after harvest. Modeling showed that this silvicultural method did not significantly reduce the number of large trees following six decades. The SRP Report (Ligon et al. 1999) thinning from below definition was stated as: "A low thinning is to be used in conjunction with silvicultural treatments in Zone A of Class I WLPZs. This thinning involves the removal of the understory, mid-canopy, and very limited numbers of co-dominant trees. Co-dominant trees may be removed only to improve spacing and enhance growth. Dominant trees may not be removed, and average stand diameter must increase following harvest." QMD is defined as the average diameter corresponding to the mean basal area. Spence et al. (1996) state that for second-growth forests, limited harvest, thinning, planting, or other manipulations may be appropriate in order to facilitate recovery and protection of key functions, particularly in coastal forests. They report that these activities should only be allowed when they can be performed without adversely impacting other riparian functions or values. Spence et al. (1996) state that the overall goal should be to restore the riparian zone to a "natural" condition, not to maintain timber production within the riparian zone over the long term.

[30] Note that this prescription would be extremely difficult to enforce with the use of single tree selection silviculture.

[31] James (2003) found that maintaining minimum 80% angular canopy cover had a minimal impact on water temperature in a northern Sierra stream. Both conifers and hardwoods are to be used for the shade measurement.

[32] Requiring the five largest conifers is proposed for interior streams due to a higher percentage of large wood coming from the first 30 feet from bank erosion (Benda 2005), as well as a higher percentage of Sierra Nevada/Cascade Range streams being boulder and bedrock dominated, where wood is less important for forming pools (SWC 2008). Berg et al. (1998) reported that few pieces of inventoried large wood in the central Sierra Nevada contributed to the formation of pools or steps.

Approach #2: Modified Prescriptive Minimum Requirements for Unconfined Watercourses with Flood Prone Areas

Option 1 (Prescriptive no-harvest for flood prone areas)

Channel Migration Zone (if present): No timber harvesting operations are permitted within channel migration zones except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). Channel migration zones tend to be more common where the valley floor is more than four (4) times the width of the bankfull channel. [33]

Core zone: The area encompassing the flood prone area, but not less than 30 feet.[34] No timber harvesting operations or salvage is permitted, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). The flood prone area is defined as the elevation equivalent to two times bankfull stage depth.[35] ***In lieu practices*** are allowed, such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. where: (1) it can be demonstrated that adequate bank stability and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).

Inner zone: Landward edge of flood prone area (two times bankfull stage) plus 70 feet. **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input. Limited to entry using the following silvicultural systems: thinning from below, commercial thinning, or single tree selection. Quadratic mean diameter (QMD) of the stand must increase after harvest for all silvicultural systems. If the commercial thinning or single tree selection methods are used, there must be a basal area retention of xxx sq ft/ac. Salvage logging is limited to current requirements in 916.9 (s),(t), and (u). All trees leaning towards the channel shall be retained. ***In lieu practices*** may be proposed.

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[33] WFPB (2004) defines an approach for delineating CMZs and protecting valuable off-channel habitats.

[34] SWC (2008) found that protection/enhancement of biological "hot spots" such as flood prone areas should be a priority.

[35] Dunne and Leopold (1978, pg 647-648) provide data for discharges of a given recurrence interval in relation to elevation of the water surface for various regions of the U.S. Rosgen (1996) states that: "To measure the width of the flood prone area, select the elevation that corresponds to twice the maximum bankfull channel depth as determined by the vertical distance between bankfull stage and the thalweg of a riffle. Field observations show that for most stream types, this elevation is associated with a <50 year return period flood, rather than with a very rare flood." For the California Coast Ranges, two times bankfull stage depth, measured from the twalweg riffle crest (illustrated in Lisle 1987), equates to approximately the 40-50 year return period flood event (i.e., the depth determined with this method inundates the 20 yr floodplain but does not stop at that elevation, and tends to preserve the riparian corridor) (Dr. William Trush, McBain and Trush, Arcata, CA, personal communication).

Core Zone plus Inner Zone:
Retain 75% (or 80%) ACD shading (not vertical overstory canopy cover). The 5 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range shall be retained. Option A: Smaller, leaning trees nearer the channel can be proposed for trading where appropriate. Option B: Retain the 5 largest trees most likely to fall towards the stream (most conducive to recruitment).

Outer zone: Landward edge of inner zone plus 50 feet (total WLPZ width is a minimum of 150 feet where evenaged silviculture is proposed above the WLPZ, but may be considerably wider with significant flood prone areas). **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater. Retain at least 25% of the residual overstory canopy from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the WLPZ, the outer zone requirement is waived. ***In lieu practices*** may be proposed.

Option 2 (Flood Prone Area BMP Option)

Channel Migration Zone (if present): No timber harvesting operations are permitted within channel migration zones except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). Channel migration zones tend to be more common where the valley floor is more than four (4) times the width of the bankfull channel.

Core zone: 0-30 ft **Streamside Bank Protection Zone**. No timber harvesting operations or salvage is permitted, except for the construction and maintenance of road crossings in accordance with applicable rules and the creation and use of yarding corridors (i.e., channel zone limitations listed in 916.9(e) (B), (C), and (D). ***In lieu practices*** such as thinning for increased conifer growth, felling trees for wood placement in the channel, restoration of conifer deficient areas, and management to promote a mix of conifers and hardwoods, etc. can be proposed where: (1) it can be demonstrated that adequate bank stability and wood recruitment will be provided, (2) the exception will contribute to maintaining or improving fully functioning habitat, (3) practice(s) proposed are known to address a primary limit on salmonid populations in that portion of a watershed. EEZ—0-30 ft for sediment control (exceptions can be proposed).

Inner zone: 30 ft to the edge of the flood prone area (two times bankfull stage), or 100 feet (whichever is greater). **High Basal Area and Canopy Retention Zone to improve salmonid habitat** by growing a sufficient number of large trees more rapidly for large wood recruitment and shading, developing vertical structural diversity, and providing a variety of species (including hardwoods) for nutrient input. Limited to entry using the following silvicultural systems: thinning from below, commercial thinning, or single tree selection. Quadratic mean diameter (QMD) of the stand must increase after harvest for all silvicultural systems. If the commercial thinning or single tree selection methods are used, basal area retention of xxx sq ft/ac. is required. Salvage logging is limited to current requirements in 916.9 (s),(t), and (u). All trees leaning towards the channel shall be retained. ***In lieu practices*** may be proposed.

BMPs for Inner Zone on Flood Prone Areas include:

1. No tractor skidding over, through, or along secondary channels (protection of overflow channels is key element).
2. Very limited, pre-flagged, pre-approved skid trails designed and laid out, used, maintained and abandoned so as to minimize risk of becoming new secondary channels by flood flows.
3. No harvest of any tree likely to recruit to the channel (i.e., leaning conifer trees)
4. Treatment of any ground disturbance greater than 100 square feet.
5. Operations conducted only in dry soil conditions.
6. Zero levels of turbid runoff.
7. All roads and landings located outside of zone (already required by 916.3(c)).
8. Retain existing hardwoods and down LWD.
9. Implement maintenance and repair actions that contribute to improving undesired existing conditions and contribute to restoring fully functioning habitat.
10. To the greatest extent possible, apply 916.4(d): no heavy equipment in WLPZ, unless approved by affected agencies.
11. Roads, skid trails, yarding corridors, falling activities, and logging dragging, should not alter the natural drainage or flow patterns.
12. Ground disturbing activity associated with operations on flood prone areas should avoid depressions that have potential of becoming flow relief ditches.
13. No site preparation.
14. Logging slash shall be generally removed from flood prone areas and slash disposal in side channels avoided. When slash is retained within the flood prone areas, scatter slash and avoid piling or other concentrations.
15. No servicing of equipment within the flood prone area.
16. Locations of all WLPZ zones and CMZs shall be designated on the ground.
17. Water drafting sites shall be located outside flood prone areas if possible (exceptions could include, but are not limited to, drafting from an existing watercourse crossing that is appropriately engineered to facilitate fully functioning habitat).
18. Avoid disturbance of vegetation and soils on flood prone areas that could increase the likelihood of erosion during flooding by limiting soil disturbing activities and by restoring any tracks or trails to an original surface.
19. Avoid disturbance of abandoned meanders, oxbox lakes, or other features that provide off-channel habitat for fish during flood flows.
20. Avoid activites that could increase potential for diversion or avulsion of stream flow out of existing channel, including breaching or lowering the elevation of natural levees.
21. Avoid damage to vegetation that provides a soil-reinforcing root network on the channel banks, including any secondary overflow channel.
22. Retain hydraulic roughness provided by trees on the floodplain surface, thereby slowing flood water velocity on floodplains, attenuating peak flood flows, and allow sediment to be deposited.

Core Zone plus Inner Zone:
Retain 75% (or 80%) ACD shading (not vertical overstory canopy cover). The 5 largest conifers per 330 ft of channel within the upper 20% of the stand diameter range shall be retained. Option A: Smaller, leaning trees nearer the channel can be proposed for trading where appropriate. Option B: Retain the 5 largest trees most likely to fall towards the stream (most conducive to recruitment).

Outer zone: Landward edge of inner zone plus 50 feet (total WLPZ width is a minimum of 150 feet where evenaged silviculture is proposed above the WLPZ, but may be considerably wider with significant flood prone areas). **Buffer the Buffer Zone for areas with evenaged silvicultural systems applied above the Class I WLPZ.** The objective of this zone is for wind resistance for buffering the buffer, wood recruitment from the outer mortality zone, microclimate control for purposes other than limiting water temperature change, and providing habitat for wildlife species. Silviculture is limited to single tree selection leaving 50% vertical overstory canopy and/or WHR class 4M or greater. Retain at least 25% of the residual overstory canopy from existing conifers. Retain wind firm trees and species. Harvesting operations may be conducted using low impact ground-based logging equipment on slopes less than 35%. In areas where single tree selection silviculture is prescribed adjacent to the flood prone areas, the outer zone requirement is waived. Exceptions for ***in lieu practices*** may be proposed.

Approach #3: Site-Specific Plans for Unconfined Watercourses with Flood Prone Areas
(based on field information and modeling)

Timber harvesting operations may be proposed for flood prone areas beyond the outer margin of a Chanel Migration Zone based upon site specific assessments that include:

1. Identifying the issues that need to be considered for watercourse and riparian protections [refer to Table 1 of *Flood Prone Area Considerations in the Coast Redwood Zone* (Cafferata et al. 2005)]
2. Describing processes that need to be considered for the issues identified above.
3. Developing a method to define a desired trajectory for watercourse and riparian conditions in the context of the entire watershed.
4. Defining how the proposed operations will aid reaching the desired trajectories.
5. Disclosing assumptions being made at each step and limits to both the science and the proposed management activities.
6. Identifying how to determine what needs to be monitored and how to conduct the monitoring.

The site-specific plan for Class I flood prone area management shall include an: (1) inventory of the flood prone area for all hydrologic, geomorphic, and biological functions present that can be affected by timber operations; (2) a determination of the category of inundation where management is proposed; and (3) an appropriate analysis for functions present in light of possible significant adverse impacts from management.

Disclosure and analysis requirements increase with increased risk associated with the proposed level of activity and the increased frequency of inundation in the flood prone area.[36]

The site-specific plan for Class I riparian management must: (1) receive concurrence from the Review Team agencies, including DFG, and (2) include a monitoring component.

[more detailed guidelines are to be developed]

[36] Language from the RPC Report (Cafferata et al. 2005). The RPC Report provides detailed information on how to conduct a flood prone area analysis.

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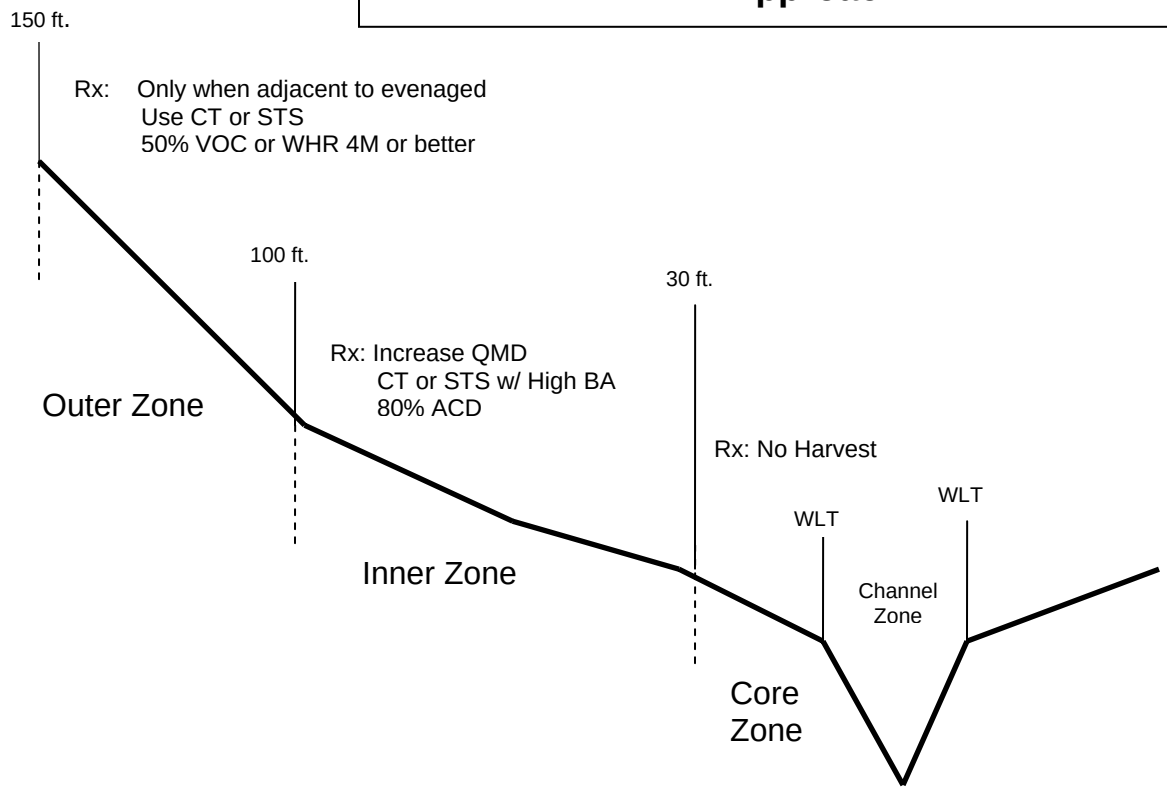
Coast District

Class I (no Flood Prone Area)
Approach 1



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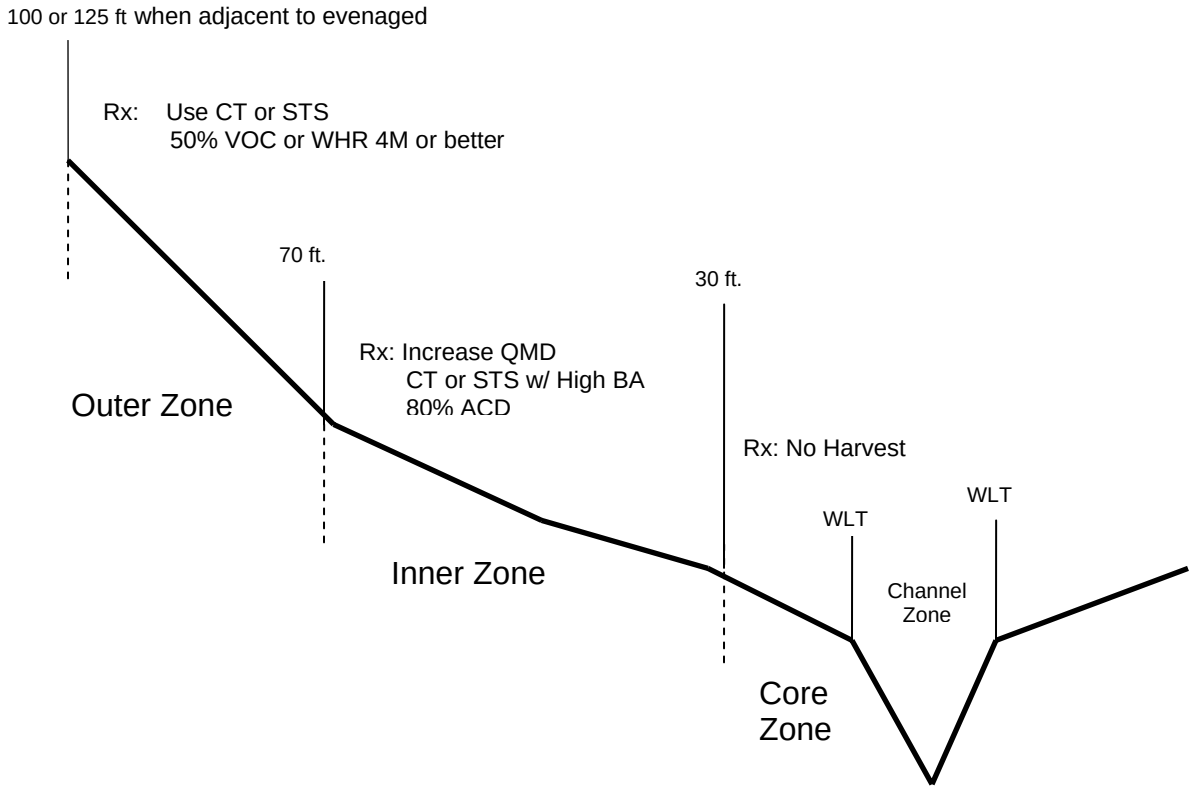
Inland

Class I (no floodplain) **Approach 1**



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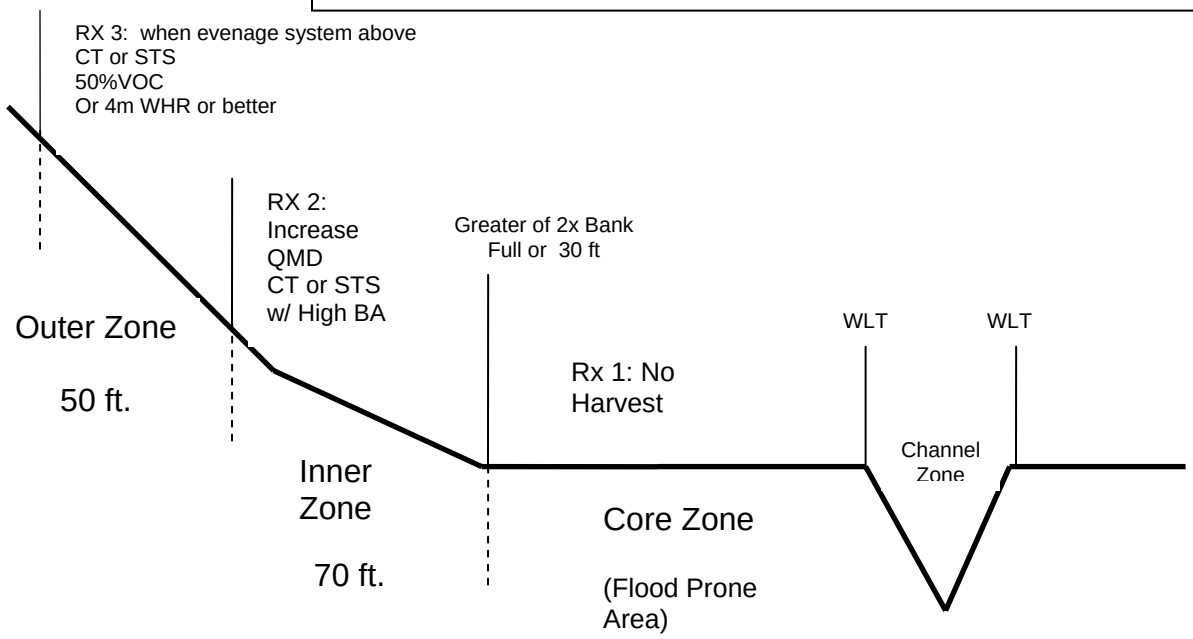
Coast and Inland

Class I w/ Flood Prone Area

Approach 2 Option 1: No harvest in FP



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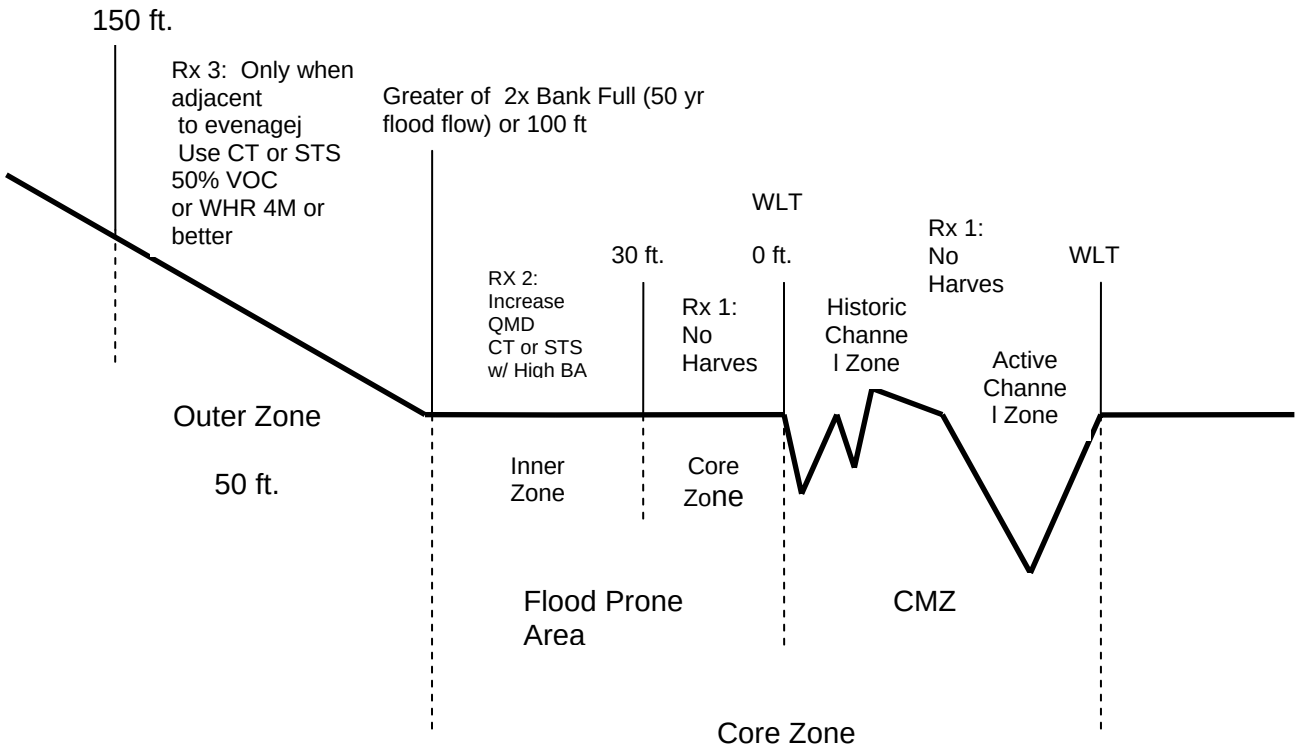
Coast and Inland

Class I Flood Prone Area and CMZ

Approach 2 Option 2: Harvesting in FPA



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