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March 20, 1997 F/SW03:VC

AQUATIC PROPERLY FUNCTIONING CONDITION MATRIX
a.k.a. Species Habitat Needs Matrix

The attached March 20, 1997 matrix, with attachments, puts forward a condition for the landscape which has been determined to be properly functioning in order to meet the habitat needs of anadromous salmonids and other aquatic species in northern California on Pacific Lumber Company's properties in Humboldt County.

The Matrix was developed using the best scientific and commercial information available. Development of the Matrix included both federal and state agencies. The primary contributors in the development include Vicki Campbell, Sharon Kramer, and Nan Reck from National Marine Fisheries Service; Chris Heppe from Environmental Protection Agency; Mark Stopher, Bill Condon and Larry Preston from the California Department of Fish and Game; Marty Berbach, Pete Cafferata and Marc Jameson from the California Department of Forestry and Fire Protection; Frank Reichmuth and Bob Klamt for the North Coast Regional Water Quality Control Board; Jim Gaither from the California Resources Agency; and, others.

This Matrix is a work in progress, designed to be fluid, responding to studies and literature not previously considered, and new research and monitoring.

Indicators in the Matrix are meant to describe landscape and aquatic habitat conditions expected to be achieved and maintained during the life of the habitat conservation plan. They also define species habitat needs for issuance of a section 10(a)(1)(B) permit in accordance with the Endangered Species Act of 1973, as amended.

AQUATIC
PROPERLY FUNCTIONING CONDITION MATRIX
a.k.a. Species Habitat Needs Matrix

March 20, 1997
Work-In-Progress
for the
PACIFIC LUMBER COMPANY HABITAT CONSERVATION PLAN

* The Matrix displays a condition for the landscape which has been determined, using the best scientific information available, to be properly functioning in order to meet the habitat needs of aquatic species.

* The Matrix below is to be used for Class I and II watercourses; Class III watercourse properly functioning conditions are found in Attachment "F".

* All indicators are interrelated, many are interdependent, and should be viewed together as a functioning system.

PATHWAY	INDICATORS	PROPERLY FUNCTIONING	REFERENCE	NOTES
Water Quality:	Temperature	11.8 - 14.6°C (53.2-58.2°F); MWAT 16.8°C (62.2°F) late summer juvenile rearing		May be lowered to meet amphibian needs. Refer to attachment "A" for information regarding methodology.
	Sediment/Turbidity	Refer to attachment "B" for Class I & II watercourses Refer to attachment "F" for Class III watercourses		High priority for research and monitoring to adjust for specific geologic formations and soil types on the north coast

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	Chemical Contamination/ Nutrients	low levels of chemical contamination from agricultural, industrial and other sources, no excess nutrients, no CWA 303d designated reaches; complies with Basin Plans	Clean Water Act and state regulations	Being further explored for appropriate verbiage and standard.
Habitat Access:	Physical Barriers	any man-made barriers present in watershed allow upstream and downstream fish passage at all flows		
Habitat Elements:	**Substrate**	Refer to attachment "B" for D-50, pebble count		
	Large Woody Debris	Refer to attachment "C" for Class I & II watercourses Refer to attachment "F" for Class III watercourses		Conditions for redwood dominated areas is being further explored; preliminary figures will be available soon.
	Pool Frequency	Refer to attachment "D" for pool frequency and attachment "C" for large woody debris		
	Pool Quality	Refer to attachment "D" and "C"; pools >1 meter deep, based on minimum residual summer depth (holding pools), with good cover and cool water, minor reduction of pool volume by fine sediment		
	Off-channel Habitat	maintain existing backwaters with cover, and low energy off-channel areas (ponds, oxbows, etc.)		

	"Hot Spots" and Refugia, (important remnant habitat for sensitive aquatic species)	maintain existing habitat "hot spots" (good habitat in limited areas) and refugia (havens of habitat safety where populations have a high probability of serving periods of adversity) at the macro scale (e.g. intact reaches, drainage, etc.); existing refugia are sufficient in size, number and connectivity to maintain viable populations or sub-populations	USDA 1993 (SAT Report)	
Channel Condition & Dynamics:	Width/Depth Ratio	maintain width/depth ratio in properly functioning streams, as determined by reaching and/or maintaining properly functioning conditions of other parameters; improve width/depth ratio in degraded streams		
	Streambank Condition	>90% stable; i.e., on average, less than 10% of banks are actively eroding		
	Floodplain Connectivity	maintain off-channel areas hydrologically linked to main channel; maintenance of overbank flows, wetland functions, riparian vegetation and succession; restore connectivity where feasible on ownership		
Flow/Hydrology:	Change in Peak/ Base Flows	watershed hydrography indicates peak flow, base flow and flow timing characteristics comparable to an undisturbed watershed of similar size, geology and geography		

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	Increase in Drainage Network	zero or minimum increases in drainage network density due to roads ; zero increase in volume capacity in natural channels so as not to degrade channel conditions		
Watershed Conditions:	**Road Management**	Entire road network (including permanent, seasonal, temporary and abandoned [legacy] roads, landings and skid trails) are storm-proofed, armored or retired (stream crossings altered so as to prevent erosion, road blocked to prevent motorized use, etc.). All intact road surfaces and drainage facilities and structures receive at least annual inspection and additional inspection during use and wet periods for proper design and function. Proper design and function evaluated according to specific performance standards pertaining to sediment delivery, drainage network density and volume capacity of natural channels. All elements of the road network found, through inspection, to not meet or high probability of not meeting performance standards must be treated, relocated or retired.		
	Disturbance History			Further discussion warranted based on outcome of PalCo's response to SYP comments from agencies

Riparian Buffer	For specifics refer to attachment "E" for Class I & II watercourses. Refer to attachment "F" for Class III watercourses. The riparian buffer system provides adequate shade, large woody debris recruitment, and habitat protection and connectivity in all subwatersheds. Includes buffers for known "hot spots" and refugia for sensitive aquatic species; percent similarity of riparian vegetation to the potential natural community/ composition is achieved		

Developed by staff in: National Marine Fisheries Service, Environmental Protection Agency, California Department of Fish and Game, California Department of Forestry and Fire Protection and North Coast Regional Water Quality Control Board

Compiled by: Vicki Campbell, National Marine Fisheries Service

Prepared for: Pacific Lumber Company habitat conservation planning effort

DATA USE AND EVALUATION

For purposes of water quality assessment and management, temperature data is used to assess impacts on any beneficial water use(s). In the North Coast Region, attention is directed to the temperature requirements of cold water fishery resources, particularly anadromous fish populations, as this beneficial use is extremely sensitive to certain temperature conditions. Wide daily variations of temperatures and elevated water temperatures can cause significant impairment of the successful propagation, rearing and survival of anadromous fish populations.

Regional Water Board staff recommends using two references for evaluating stream temperatures:

1. Temperature Criteria for Freshwater Fish: Protocol and Procedures published by U.S. EPA in 1977.

2. Guidance for Evaluating and Recommending Temperatures Regimes to Protect Fish, Instream Flow Information Paper 28, Carl Armour, U.S. Fish and Wildlife Service, 1991.

Maximum Weekly Average Temperature Requirements (MWAT)

The MWAT is the mathematical mean of multiple, equally spaced, daily temperatures over a 7-day consecutive period. A minimum of two data are required to determine the MWAT: the "physiological optimum temperature" (OT) and the "upper ultimate incipient lethal temperature" (UUILT). While the OT can be measured for numerous physiological functions, growth appears to be the most sensitive function. The UUILT is the "breaking point" between the highest temperatures to which an animal can be acclimated and the lowest of the extreme upper temperatures that will kill the organism.

MWAT is calculated as follows:

$$MWAT = OT + \frac{UUILT - OT}{3}$$

OT = a reported optimal temperature for the particular life stage or function.

UUILT = the upper temperature that tolerance does not increase with increasing acclimation temperatures.

We have calculated a MWAT for juvenile coho for late summer rearing and found a narrow range of temperatures which are dependent on acclimation temperature:

acclimation temperature	UUILT	OT	MWAT
15°C	24°C	13.2°C	16.8°C
20°C	25°C	13.2°C	17.1°C
>23°C	25.8°C	13.2°C	17.4°C

The OT is the average of the preferred temperature range which is reported to be 11.8 C to 14.6 C (Reiser and Bjorn, 1979, Influence of Forest and Rangeland Management of Anadromous Fish Habitat in the Western United States and Canada, USDA Forest Service Technical Report PNW-96).

Draft Properly Functioning Conditions for Sediment Levels (3/20/97)

Purpose of table: Identify properly functioning salmonid habitat and other beneficial use target conditions relative to instream sediment levels and hillslope sediment delivery mechanisms on PL ownership. Sediment is one of several water quality and habitat variables used for evaluating watershed health and impacts of management proposals.

Selection of Parameters and Targets: The listed parameters are based on lab and field research conducted throughout the Pacific Northwest (as described in Chapman 1988, Bjornn and Reiser 1991 and others) as well as a limited amount of localized information from Northern California (Knopp 1993, Burns 1970). Baseline data for some of the parameters (e.g., V*, pebble count) are not currently available for PL lands. PL may wish to incorporate those parameters into their monitoring program for future indication of sediment conditions and effectiveness of management actions. Ideally, additional research and monitoring data from Northern California will provide information from which to derive watershed-specific target conditions.

Watershed Analysis and Interim Targets: Given the natural variation in sediment loading between and within watersheds, a watershed inventory and analysis should determine existing sediment levels and identify reasonable interim targets, timeframes and management actions necessary to achieve long-term goals. A watershed analysis including some form of sediment budget, should clearly define baseline conditions and identify relative contributions of sediment from different natural and human-induced sources (e.g., mass wasting, surface erosion, roads, in-channel storage, etc.).

Biological impact/concern	Parameter	Numeric or narrative target	Reference	Recommended Method	Sampling locations
Decrease in embryo survival due to reduction in gravel permeability, pore space and dissolved oxygen	%fines <0.85mm	<11-16%	Based on research described in Peterson et al. (1992) for TFW, Chapman (1988) and Burns (1970) baseline data from S. Fork Yager	Valentine Protocols (1995) using McNeil core samplers	Pool/riffle breaks, <3% gradient
Entrapment of fry emerging from redds	%particles <6.35mm	<20-25% (Steelhead and Chinook)	Bjornn and Reiser (1991), McCuddin (1977)	same	same
Measure of spawning gravel quality	Geometric Mean Diameter	>20mm	Shirazi and Seim (1979)	Shirazi and Seim (1979)	n/a
Measure of pore size and permeability of spawning gravel	Fredle Index	>9 (coho)	Lotspeich and Everest (1981)	Lotspeich and Everest (1981)	n/a
Measure of rearing/adult holding habitat in pools	V*	<20%	Knopp (1993)	Lisle and Hilton (1992)	3rd order, <3% gradient streams
Measure of substrate rearing habitat quality	Pebble count (D50)	65-95mm	Knopp (1993)	Knopp (1993)	same

Suspended sediment potentially impacts migrating juvenile/adult salmon	Turbidity	No visible increase in turbidity due to timber operations in Class I, II, & III watercourses and inside ditches that discharge directly to watercourses.	Modified from Road Use Mitigation Memo by PL (May 20, 1996)		Class I, II, III watercourses and inside ditches that discharge directly to watercourses.
Measure of scour and fill of streambed sediments impacting incubation	Scour Chains	Trend toward less deposition	Nawa and Frissell (1993)	Nawa and Frissell (1993)	low gradient, low confinement
Hillslope sediment delivery mechanisms	Surface erosion and mass wasting from management activities	Zero net discharge of sediment in non-303(d) listed waterbodies Net decrease in sediment delivery from management activities in 303(d) listed waterbodies (Numeric goal to be determined)			
Benthic macroinvertebrate production and diversity	Macroinvertebrate population and/or diversity indices	To be determined	U.S. EPA Rapid Bioassessment Protocols as adapted by CA DFG		

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Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society. Vol. 117, No. 1.

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McCuddin, Michael 1977. Survival of salmon and trout embryos and fry in gravel-sand mixtures. Master's Thesis. University of Idaho, Moscow.

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Properly Functioning Condition for Large Woody Debris, including "Key Pieces"

Relationship between channel width and mean for debris diameter, length and volume and the number of pieces of debris in old-growth Douglas-fir forest streams (from Bilby and Ward 1989; Fox 1994)

Channel Width (feet)	Bilby and Ward				Fox "Key Pieces"[5]			
	Debris per 100 feet[1]	Geometric mean debris diameter (inches)[2]	Geometric mean debris length (feet)[3]	Mean debris piece volume (cubic feet)[4]	Debris per 100 feet	Average debris diameter (inches)	Average length (feet)	Average debris piece volume (cubic feet)
15	16	14	18	13	3.3	16	27	35.3
20	12	16	20	26	2.5	22	32	88.3
25	9	17	22	38	2.0			
30	7	18	25	51	1.7			
35	6	19	27	63	1.4	25	59	211.9
40	5	21	29	75	1.2			
45	5	22	31	88	1.1			
50	4	23	33	100	1.0	28	78	317.8
55	4	25	35	113	1.0			
60	3	26	37	125	0.8			
65	3	27	40	137	0.8			

1/ Log_{10}debris frequency/100ft = -1.12*(log_{10}channel width in feet*0.3048) +0.46*0.3048*100
2/ Geometric mean diameter (in.) = [2.14(channel width in feet*0.3048)+26.43]/2.54
3/ Geometric mean length (ft.) = [0.43*(channel width in feet*0.3048)+3.55]*3.281
4/ Mean debris piece volume(cu.ft) = [0.23(channel width in feet*0.3048)-0.67]*$(3.281)^3$
5/ A "key piece" is defined as:

"...a log/and or root-wad that:
1) is independently stable in the stream bankfull width (not functionally held by another factor; i.e. pinned by another log, buried, trapped against a rock or bedform, etc.); and
2) is retaining (or has the potential to retain) other pieces of organic debris. Without this "Key piece", the retained organic debris will likely become mobilized in a high flow (approximately a ≥ 10-year event) (Fox 1994)."

References and notes

Bilby, R.E. and J.W. Ward 1989. Changes in characteristics and function of woody debris with increasing size of streams in western Washington. Transactions of the American Fisheries Society. 118:368-378.

Fox, Martin 1994. Draft revisions of the WSA Fish Module Diagnostic Matrix: LWD assessment. Muckleshoot Indian Tribe Fisheries Department dated June 6, 1994.

wmc:2/22/97

Properly Functioning Conditions for Pool Habitat

Purpose of table: Identify properly functioning pool habitat conditions that will provide juvenile rearing habitat, adult holding habitat, and, potentially, thermal and velocity refugia, during all seasons of freshwater residency.

Approach for achieving goals: Watershed analysis should determine existing pool habitat quantity and quality and the distribution of good pool habitat and its spatial relationship to key thermal refugia and spawning areas.

Biological Impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Loss of pool quantity: Loss of juvenile rearing habitat: Juveniles leave stream systems at smaller sizes/younger ages and are subject to greater mortality expressed by smaller return ratios. Loss of adult holding habitat: Deep pools that provide holding habitat particularly escape cover and resting areas for adults of runs that enter streams during low flows and mature in fresh water are lost, thus fewer, or none, of those adults, reproduce successfully		In streams with gradients >=3% and average widths < 10 meters (based on Little Lost Man Creek).	Keller et al. 1995 a/Grant et al. In press a/Nakamura and Swanson 1993	Measure distance from point of maximum depth to point of maximum depth.	Response reaches in conjunction with sediment and water temperature. Probably downstream of tributary confluences (Klein 19[ ] Advances in Hydro-Science and Engineering, Vol 1, Wang (ed)).
	Number of pools per mile equivalent to pool to pool spacing based on bfs widths	Pool to pool spacing 1 pool per every 3 bfs channel widths on average (a/).			
	Percent of stream surface area comprised of pool habitat	pool area >=20% of the total stream surface area,			
	Percent of number of pools associated with LWD	and >=90% of # of pools associated with LWD	Keller et al. 1995		
		In streams with average gradient <3% and average widths <=18 meters (based on Prairie Creek).	b/Leopold et al. 1964 b/Keller and Melhorn 1978 b/Nakamura and Swanson 1993		
	Number of pools per mile equivalent to pool to pool spacing based on bfs widths	Pool to pool spacing 1 pool per every 6 channel widths on average (b/),			
	Percent of stream surface area	pool area >=25% of the total stream			

ATTACHMENT D

	comprised of pool habitat Percent of number of pools associated with LWD	surface area, 50% of the stream surface area composed of pool habitats (c/) 50% of # of pools associated with LWD	Peterson et al. 1992		
Loss of summer refugia: Fish experience increased predation and potentially thermal stress resulting in decreased rates of survival. Loss of winter refugia: Fish that can not escape from high velocities during high winter flows can be flushed from the system resulting in smaller return ratios, higher mortality from stress (turbidity, starvation) can occur	Maximum depth Volume Cover	>=3 feet maximum depth, V* -- (see sediment table) The assumption is made that if LWD levels, bank stability, and riparian stand conditions are met, cover will be adequate	Platts 1983,	Residual maximum pool depth during summer low flows.	same

Notes:

Beschta, R.L. and W.S. Platts. 1986. Morphological features of small streams: Significance and function. Water Resources Bulletin, Vol. 22, no. 3, P. 369 - 378.

-Primary and secondary pools...a variety is needed for various age-classes

-Nearly 90% of the pool-riffle sequences may consist of channel reaches 3 to 9 channel widths in length.

-Thus the size, frequency, distribution, and quality of pools in a stream depend upon the mechanisms of formation and other characteristics such as size of channels substrates, erodability of banks, and depth of flow.

Grant, Swanson, and Wolman (GSA Bulletin manuscript in review)

-Richards (1978 a,b) and Milne (1982a) corroborated that pool-to-pool spacing is a function of channel width.

-The frequency distribution of pool-to-pool spacing in boulder bedded streams peaked between 2-4 active channel widths, though some streams had bimodal distribution with a primary peak at three and a secondary peak at 6 (with a range as high as 45).
-Church and Gilbert (1975) observed that small streams and torrents seemed to have dominant wavelengths of 2- 3.5 times the channel width.
-Milne (1982a) noted that bed form spacings can easily be upset by variation in sediment mixtures and the presence of 'residual' bedload...which disallowed the high bed-transport rates that produce regular repeating distances.
-Field observations suggest that distinct channel units do not form where sediment supply is high and channels are wide. Instead, braiding occurs and channel bed morphology is characterized by long, featureless rapids (Fahnestock, 1963; Ikeda, 1975).

Keller, E.A., A. MacDonald, T. Tally, and N.J. Merrit. 1995. Effects of large organic debris on channel morphology and sediment storage in selected tributaries of Redwood Creek, northwestern California. IN Geomorphic processes and aquatic habitat in the Redwood Creek basin, northwestern California. U.S. Geological Survey Professional Paper 1454. Nolan, K.M., H.M. Kelsey, and D.C. Marron, (ed.s). U.S. Gov. Print. Office, Washington.

Keller, E.A. and W.N. Melhorn. 1978. Rhythmic spacing and origin of pools and riffles. Geo. Soc. of Am. Bul. V. 89, p. 723 - 730.
-70% of the variability of spacing in pools can be explained by variability in channel width.
-Alluvial and bedrock channels in different climates had pool spacing that was statistically from the same population.
-Pool to pool spacing is determined by measuring the distance between the maximum depths of adjacent pools.
-Channel width is measured at a point on the riffle between pools where the cross-channel profile is nearly symmetrical and the banks well defined, and is delineated by the width of bed material or the distance between major breaks in slope from the bottom of the channel to the banks of the channel.
-The average spacing is six times the channel width...the conclusion of Leopold and others (1964) that pools are spaced approximately five to seven times the channel width.

Peterson, N.P., A. Hendry, and Dr. T.P. Quinn. 1992. Assessment of cumulative effects on salmonid habitat: Some suggested parameters and target conditions. Prepared for the Washington Dept. of Natural Resources and the Cooperative Monitoring, Evaluation and Research Committee Timber/Fish/Wildlife Agreement. TFW-F3-92-001. Center for Streamside Studies, UW, Seattle, WA 98195.

Nakamura, F., and F.J. Swanson. 1993. Effects of coarse woody debris on morphology and sediment storage of a mountain stream system in western Oregon. Earth Surf. Proc. and Landf. v.18, p. 43-61.

[see also: Elser 1968, Lewis 1969.]

Properly Functioning Condition for Riparian Forests and Buffer

Purpose of table: Identify properly functioning riparian zone conditions relative to producing targeted levels of large woody debris, maintaining targeted temperature regimes, mitigating potential sediment effects from materials delivered through overland flow and bank cutting, and late-successional forest habitat. The latter includes retention of key habitat elements, including large snags, large woody debris on the forest floor and large sized trees.

Approach for achieving goals: Watershed analysis should determine existing riparian zone stand structure and composition as well as potential to provide key watershed inputs including large woody debris, stream-bank stability and to function in maintaining targeted temperature regimes and late-successional forest habitat structure and composition.

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Low large woody debris (LWD) recruitment potential	Quadratic mean tree diameter (QMD) (/1) of fully-stocked stands	≥ 24 in. dbh or ≥ targeted ave. "key piece" LWD diameter (/2), whichever is greater	Bilby and Ward 1989, Ca. Board of Forestry 1997, Fox 1994	USDA Forest Service 1995	distal to outer margin of channel migration zone (/3)
	Ave. number of large trees per acre by dbh class	Redwood: 23.8 > 32 in. 17.4 > 40 in. PER ACRE	Redwood (SAF Type 232)	same	same
		Douglas-fir: (/x) 18.5, 16.3 > 30 in. 11.0, 9.0 > 40 in. PER ACRE	Douglas-fir/mixed evergreen (SAF Type 234)		
High mid- to late-summer water temperature regimes	Overstory tree canopy closure	Ave. of at least 85 percent overstory tree canopy closure (/4)	Flosi and Reynolds 1994 2090 south of S.F. BAY	USDA Forest Service 1995; Ganey and Block 1994	same, assessed for every 200-ft section of riparian zone, on each side of stream

ATTACHMENT E

Properly Functioning Condition for Riparian Forests and Buffer (continued)

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large downed woody debris for near-stream habitat complexity and filter strip function	a) Ave. tons of large organic debris per acre;	a) <u>redwood</u>: to be determined from samples of old-growth redwood forest riparian zones <u>Douglas-fir</u>: 24.2 tons per acre of materials greater than 10 inches on small end	Jimerson et al. 1996 [DOUG-FIR]	USDA Forest Service 1995	distal to outer margin of channel migration zone
	b) Ave. number of large pieces of wood on ground per acre	b) <u>redwood</u>: to be determined from samples of old-growth redwood forest riparian zones <u>Douglas-fir</u>: >30" 3.8 >20"&<30" 6.9 >15"&<20" 6.3 >10"&<15" 12.7	Jimerson et al. 1996 [DOUG-FIR]		
	c) percent surface cover and undisturbed area	c) at least ~~25~~ 95 percent	Ca. Board of Forestry 1997 HILLSLOPE		

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Properly Functioning Condition for Riparian Forests and Buffer (continued)

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large snags for near-stream habitat complexity and to supplement potential LWD	Snags per acre ≥ 30 in. dbh	Ave. of at least three snags per acre ≥ 30 in. dbh (/5)	Richter 1993	same	same, assessed over at most 10 acres of riparian zone (/6
Loss of vegetative cover and sediment effects from stream bank erosion	Stream bank stability	"Good" to "Excellent" stream bank stability afforded by root systems of large trees supplemented by large wood and shrub layer	Pfankuch 1978 • Refer to matrix stream bank stability parameter	Pfankuch, 1978	Lower and upper banks (Pfankuch 1978) and channel migration zone

/1 Only trees > 5 in. dbh are included in QMD calculations. Confidence interval of ± 5 percent at 95 percent.
/2 See tables under "Targeted Conditions for Large Woody Debris."
/3 See channel migration zone definition in "Aquatic Conservation Strategy" (USDA and USDI 1994, "Record of decision.")
/4 Increase to greater than 90 percent where temperature regimes do not meet the criteria for "properly functioning."
/5 Assuming a 100-foot-wide zone on both sides, this would be equivalent to ≥ 1.4 large snags of this size per 100 feet of stream.
/6 Assuming a 100-foot-wide zone, this would be equivalent to an assessment per 0.8 miles of stream.

→ corrections from 3/3/97 meeting.

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Franklin, Jerry; Kermit Cromack Jr., William Denison, Arthur McKee, Chris Maser, James Sedell, Fred Swanson and Glen Juday. 1981. Ecological characteristics of old-growth Douglas-fir forests. U.S.D.A. Forest Service General Technical Report PNW-118. Pacific Northwest Forest and Range Experimental Station, Portland, Oregon. 48 p.

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Society of American Foresters no date. Structural characteristics of old-growth forests (SAF types) by Dunning site classes.

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U.S. Department of Agriculture and U.S. Department of Interior 1994. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern Spotted Owl, Attachment A: Standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the Northern Spotted Owl; 74 pages with attachment.

wmc:2/23/97

Attachment II

Properly Functioning Condition for Class III Watercourses

Purpose of table: Identify properly functioning conditions within zones containing class III watercourses. These conditions relate to producing targeted levels of large woody debris for terrestrial species and for delivery to aquatic habitats, mitigating potential sediment effects to class I and II habitats and associated species from sediment delivered through class III watercourses and producing key habitat elements. The latter includes retention and production of large snags, large woody debris on the forest floor and large trees.

Approach for achieving goals: Watershed analysis should determine the existing stand structure and composition of trees, snags and downed woody materials and other elements along class III watercourses, evaluate the risk of sediment effects to aquatic species (including salmonids, salamanders and frogs) from timber operations near class III watercourses, evaluate the potential to provide key watershed inputs including large woody debris, stream-bank stability and to function in maintaining targeted hill slope habitat structure and composition.

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Low snag and large woody debris (LWD) recruitment potential	Ave. number of green trees per acre by dbh class	All species: (/1) 3 > 11 in., < 15 in. 3 > 15 in., < 30 in. 3 > 30 in.	Bisson et al. 1997, Cline et al. 1980, Freel, 1991, Richter, 1993	USDA Forest Service 1995	within "equipment exclusion zone" (/2)
Maintain large snags for near-stream habitat complexity and to supplement potential LWD	"Soft" and "hard" snags per acre	All species: 1, 1 >11in.< 15in. 1, 1 >15in., <30in. 1, 1 > 30 in.	Cline et al., 1980, Freel, 1991, Richter, 1993	same	same

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Maintain large downed woody debris for habitat complexity and filter strip function	a) Ave. tons of large organic debris per acre;	a) redwood: to be determined from samples of old-growth redwood forests Douglas-fir: 24.2 tons per acre of materials greater than 10 inches on small end	Jimerson et al. 1996	USDA Forest Service 1995	within equipment exclusion zone
	b) Ave. number of large pieces of wood on ground per acre	b) redwood: to be determined from samples of old-growth redwood forests Douglas-fir: >30" 3.8 >20"&<30" 6.9 >15"&<20" 6.3 >10"&<15" 12.7	Jimerson et al. 1996		
	c) Percent surface vegetative cover	c) at least 95 percent surface vegetation	Ca. Board of Forestry hill slope monitoring study (/3)		

Biological impact/concern	Parameter	Numeric or narrative target	Reference(s)	Recommended Method	Sampling locations
Loss of vegetative cover and sediment effects from stream bank erosion	Stream bank stability	"Good" to "Excellent" stream bank stability afforded by root systems of large trees supplemented by large wood and shrub layer	Pfankuch 1978	Pfankuch, 1978	Lower and upper banks (Pfankuch 1978)

/1 This number of trees in each size class would be permanently marked for retention prior to each harvest entry.
/2 Equipment exclusion zones will be established along all class III watercourses. Zone widths will vary according to slope class, silvicultural prescription, yarding method and method of site preparation, slope location (e.g., upslope vs. "inner gorge") and downstream resources to be protected.
/3 Personal communications from Peter H. Cafferata, California Department of Forestry and Fire Protection, March 3, 1997 and based on information obtained through the Hill slope Monitoring Study funded by the California Board of Forestry.

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