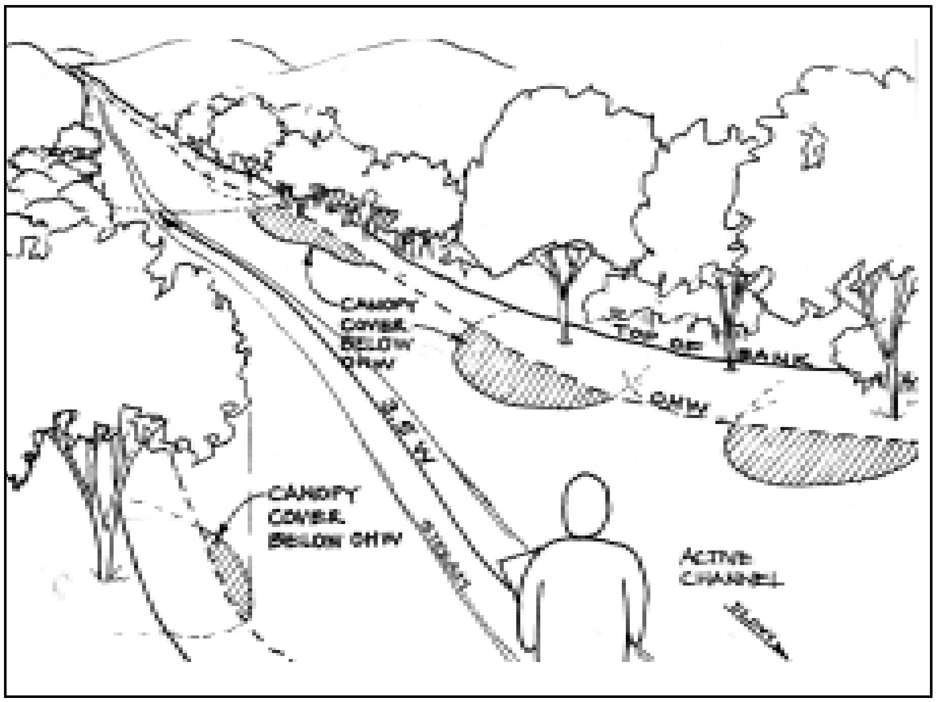
Variable: SHADE OVER THE STREAM CHANNEL (V_{SHADE})

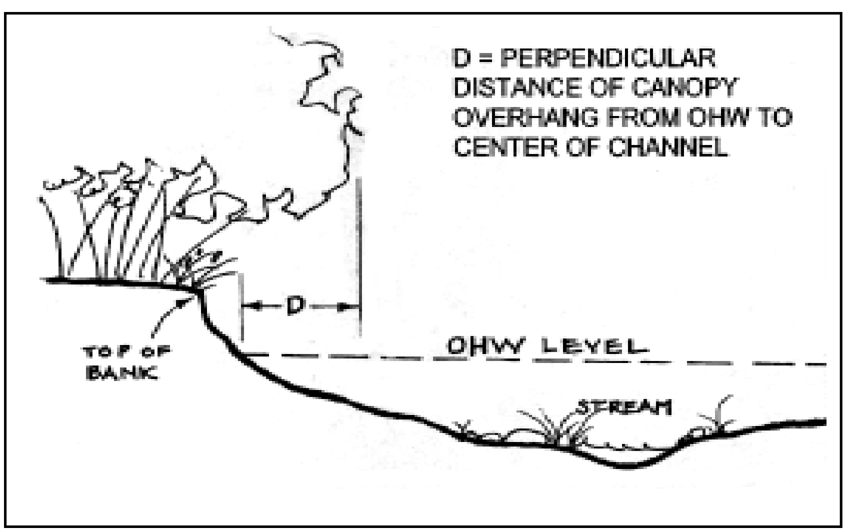
calculate the average canopy cover over the active channel and for the average overhang distance. To determine a shade index for the VAA, multiply the average distance measurement of canopy overhang by the average percent canopy coverage (in decimals; *i.e.*, 60% = 0.60)

Figure 5.15 Measurement protocol for the shade variable (V_{SHADE})

a.



b.



Variable: SHADE OVER THE STREAM CHANNEL (V_{SHADE})

Data Located in Appendix B-33 through B-60

Scaling Rationale The Authors scaled V_{SHADE} using a combination of reference data, field observations, and best scientific judgment. To begin, the Authors analyzed reference data for the three subclasses separately. Similarities in shade conditions between High and Moderate gradient subclasses led us to group these subclasses for scaling purposes. Generally, the Authors assumed that High and Moderate gradient stream channels with a significant proportion of overhanging shade represented the reference standard condition (see Table 5.20 below). For example, the data indicate that reference standard conditions in the Moderate and High gradient subclasses have a shade index of greater than 30. The reference standard site in the High gradient reaches of Cold Spring Creek (Site #9) had 95% canopy coverage over the active channel and an overhang of approximately 50 ft. Using these data, Site #9 had a shade index of 47.5.

With respect to the Low gradient subclass, the Authors expected significantly less canopy coverage over the active channel due to the extent of human activities in comparison to Moderate and High gradient subclasses (see Table 5.21 below). In view of the fact that the Authors did not find a reference standard site in the Low gradient subclass, the Authors used reference system data and best professional judgment to project reference standard conditions. The Authors' projections indicate that reference standard conditions in the LOW gradient subclass should have a shade index of greater than 15.

Table 5.20 Mean, standard deviation and range of the average canopy overhang and the percent canopy coverage for High and Moderate gradient subclasses

Land Use Gradient	Sample Size	Shade Index (Mean, SD, Range)	
Unaltered / Reference Standard	4	18 ± 19.9	(5 to 48)
Minimally Altered	10	9.8 ± 6.1	(0 to 22)
Moderately Altered	16	9.9 ± 10.9	(0 to 30)
Extensively Altered	8	3.2 ± 3.5	(0 to 10.5)
Unrecoverable	0	0	

Variable: SHADE OVER THE STREAM CHANNEL (V_{SHADE})

Table 5.21 Mean, standard deviation and range of the average canopy overhang and the percent canopy coverage for Low Gradient subclass

Land Use Gradient	Sample Size	Shade Index (Mean, SD, Range)	
Unaltered / Reference Standard	0	0	
Minimally Altered	2	18.1 ± 3.6	(16 to 21)
Moderately Altered	3	2.0 ± 2.9	(0 to 5.5)
Extensively Altered	10	2.2 ± 4.3	(0 to 13)
Unrecoverable	2	0	

Scaling for High and Moderate Gradient Subclasses

MEASUREMENT CONDITION FOR V_{SHADE}	INDEX
Shade index is ≥ 30.	1.00
Shade index is ≥ 20 and < 30.	0.75
Shade index is ≥ 10 and < 20.	0.50
Shade index is ≥ 1 and < 10.	0.25
a Shade index is 0 **and** b Variable is recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a Shade index is 0 **and** b Variable is not recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

Variable: SHADE OVER THE STREAM CHANNEL (V_{SHADE})

Scaling for the Low Gradient Subclass

MEASUREMENT CONDITION FOR V_{SHADE}	INDEX
Shade index is ≥ 15.	1.00
Shade index is ≥ 10 and < 15.	0.75
Shade index is ≥ 5 and < 10.	0.50
Shade index is ≥ 1 and < 5.	0.25
a Shade index is 0 **and** b Variable is recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a Shade index is 0 **and** b Variable is not recoverable and not sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

Confidence

The Authors' confidence that reasonable logic and/or data support scaling is MEDIUM for High and Moderate Gradient subclasses and LOW to MEDIUM for Low Gradient subclass, due to limited data for all variable conditions and especially due to the absence of reference standard data.

SHRUB CANOPY COVER ($V_{SHRUBCC}$)

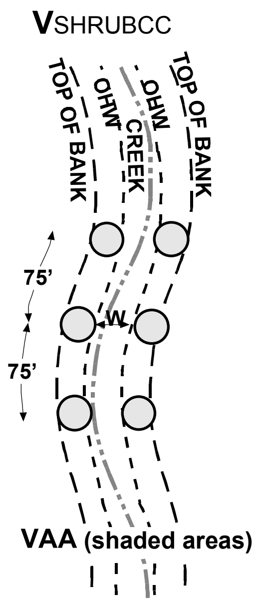
Definition

Shrub Canopy Cover is the percent canopy cover of shrubs (multiple stemmed woody species) within the VAA.

Rationale for Selection of the Variable

Shrub canopy coverage is one measure of vegetation that indicates maintenance of native plant community structure and function. As such, shrub canopy cover can be used along with other measures of vegetation cover to indicate the potential for a site to support characteristic ecosystem processes, such as maintenance of native and nonnative plant communities, faunal communities and faunal support/habitat, *etc.* The presence of shrubs along with that of trees, contributes to roughness and topographic variation on floodplain and channel sites. Roughness provides a mechanism to slow water flows and thus provides static and dynamic storage of flood flows as well as cover for aquatic and terrestrial fauna. Shrubs, along with trees, maintain channel morphology by increasing bank shear strength through the production and maintenance of fine root biomass. Shrubs also function as structural elements that limit and/or control development and maintenance of channel geometry.

Shrubs provide allochotonous inputs of labile and refractory organic carbon to riverine ecosystems. In addition, the shrub canopies alter micro-climatic conditions in riparian forests (*e.g.*, moisture, nutrients, light, temperature, wind speed *etc.*). Microclimatic alterations caused by the presence of shrubs is important in maintaining several ecosystem functions, such as biomass production, maintenance of site water balance, nutrient conservation, habitat structure, *etc.* Furthermore, shrubs, along with trees, are instrumental in soil genesis, elemental cycling, and successional processes (Hooper and Vitousek 1997). These successional processes include the dispersal and establishment of plant propagules, which support plant and animal species diversity and turnover (Tilman 1982, Huston and Smith 1987, Cohen and Levin 1991, Tilman and Pacala 1993).



Measurement Protocol

The VAA for V_{SHRUB} consists of six 0.1-acre circular plots(radius 37.3 ft) established along the two vegetation transects, located on stream right and stream left. To meassure $V_{SHRUB,}$ utilize the six plot centers on the two vegetative transects, stream right and stream left, to define the 0.1-acre circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent canopy cover for the shrub stratum (Figure 5.11) using midpoints of standard canopy cover classes (Appendix E.6). Record these estimates of percent cover on the Minimum Submittal Worksheet provided in Chapter 7. Average the six measurements of shrub canopy cover to calculate the final estimateof shrub cover.

Variable: SHRUB CANOPY COVER ($V_{SHRUBCC}$)

Data Located in Appendix B-33 through B-60

Scaling Rationale The Authors scaled $V_{SHRUBCC}$ using reference data, field observations, and best scientific judgment. Specifically, reference data for all three subclasses were grouped according to similarities in plant community structure. Reference data were analyzed to determine average shrub cover (by cover class midpoint) for each plot. This provided the Authors with ranges of shrub canopy coverage that were used to describe the natural range of variation of shrub dominance within forested riparian communities of the SCSBC. Canopy coverage values for shrubs exhibited substantial variation within all subclasses, and differences among subclasses did not warrant development of individual scales for each subclass. In general, sites that were either intact without substantial perturbation by humans or late successional, supported comparatively low $V_{SHRUBCC}$ values. Early successional sites and/or those impacted by humans tended to support higher shrub canopy coverage within the PAA.

Table 5.22 Mean, standard deviation and range of percent cover for shrubs within all subclasses

Disturbance Gradient	Sample Size	Percent Cover of Shrubs (Mean, SD, Range)	
Unaltered / Reference Standard	4	9.25 $\pm$ 8.29	(3.00 to 20.50)
Minimally Altered	13	15.25 $\pm$ 12.09	(0.0 to 38.0)
Moderately Altered	18	22.21 $\pm$ 16.67	(3.0 to 63)
Extensively Altered	20	19.65 $\pm$ 14.33	(0 to 38)
Unrecoverable	2	0 ; 0 to 0	

Variable: SHRUB CANOPY COVER ($V_{SHRUBCC}$)

Scaling for High, Moderate, and Low gradient subclasses

MEASUREMENT CONDITION FOR $V_{SHRUBCC}$	INDEX
a. Average shrub canopy cover > 3% and < 10%, **and** b. Vegetation is unaltered by human activities.	1.00
a. Average shrub canopy cover > 3% and < 10%, **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, parks, urban/suburban development, flood control access, *etc.*)	0.75
a. Average shrub canopy cover > 10% but < 30%, **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, parks, urban/suburban development, flood control access, *etc.*)	0.50
a. Average shrub canopy cover > 0 and < 3%, **and** b. Vegetation below top of bank is recently altered (within the last 5 years) by human activities, **or** c. Average shrub canopy cover > 30%.	0.25
a. Average shrub canopy cover is 0% due to human modifications that prevent the establishment of vegetation (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) **and** b. Variable is recoverable and sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Average shrub canopy cover is 0% due to human modifications that prevent the establishment of vegetation (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.00

Confidence The Authors' confidence that reasonable logic and/or data support scaling is HIGH for all subclasses.

SNAGS (V_{SNAG})

Definition

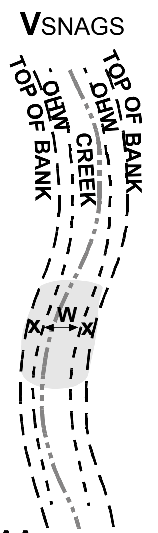
Snags refers to the basal area of standing dead trees (snags) > 3” DBH.

Rationale for Selection of the Variable

Snags provide habitat structure for birds, small mammals, herpetofauna, and several other classes of terrestrial and aquatic invertebrates and vertebrates. Additionally, snags contribute refractory organic carbon (detritus) to terrestrial and aquatic ecosystems. This carbon serves as an energy source that provides the basis for several ecosystem processes, (*e.g.,* decomposition, nutrient cycling, energy transfer, *etc.*).

Within active primary and secondary channels and on flood plains, snags are important sources of wood that contribute to the development of channel and flood plain structure, hydraulic complexity, and bank stability.

Measurement Protocol



VAA (shaded area)
x’s are center point of plotless cruise

The VAA for V_{SNAG} is the area surrounding the plot centers for the circular vegetative sample plots proximate to the PAA cross section of stream right and stream left. To develop a measure for $V_{SNAG,}$ begin at the plot center for the circular vegetative sample plots. At each of the plot centers, use a standard plotless cruise with a basal area factor (BAF) 10 prism or angle gauge (see Figure 5.16) to determine estimates for the average snag basal area per acre. Remember that a snag has been defined herein as dead, single-stemmed woody vegetation that is greater than 3” DBH and upright to an angle of 45° or greater. Protocols for BAF 10 plotless cruises are summarized in (Avery 1967 & Appendix E). Average the basal area estimates for the two basal area plots to yield an estimate of snag basal area and express snag basal area on a per acre basis. Record results on the Minimum Submittal Worksheet provided in Chapter 7.

In the absence of a BAF 10 prism or angle gauge, establish a fixed area plot (*e.g.,* 1/10 acre circular plot - radius 37.23 ft) and measure the DBH of each snag within the sample plot. Convert all DBH measurements to basal area using the equation for the area of a circle. Sum all basal area estimates to develop an estimate of total snag basal area, and then convert the snag basal area measurement to a per acre basis using the following formula. See Appendix E for an example of the above calculations.

Data

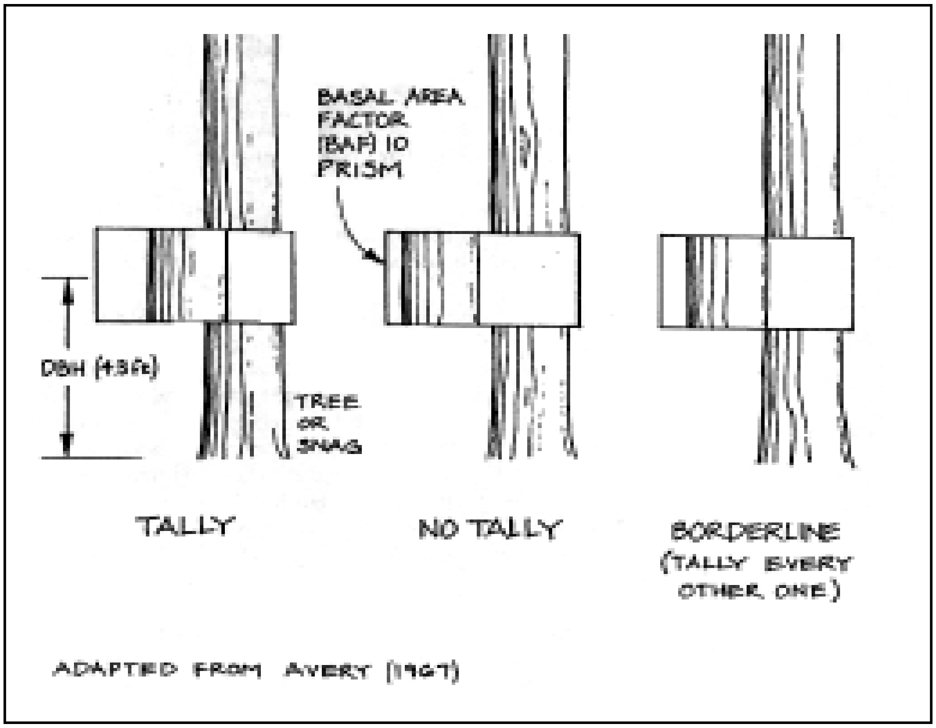
Located in Appendix B-33 through B-60

Scaling Rationale

The Authors scaled V_{SNAG} using reference data, field observations, and best scientific judgment. For the scaling of V_{SNAG}, the Authors used snag basal area determinations from a point-centered quarter sampling technique rather than using prism data because snag density was measured using the former sampling protocol during the reference sampling effort.

Variable: SNAGS (V_{SNAG})

Figure 5.16 Measurement protocol for the basal area of tree and snag variables (V_{TREEBA}) and (V_{SNAG})



Snag basal areas were observed to vary considerably within and among subclasses. Some of the recorded variation appears to be the result of natural causes (*e.g.,* cyclical droughts, successional processes, *etc.*). However, some of the higher recorded densities of snags, particularly within the Low gradient subclass, are likely the result of the invasion of exotic pests or parasites, water stress due to groundwater extraction, or other anthropogenic sources. Scaling of V_{SNAG}, therefore, is based on a range of basal area values as well as a qualitative statement of conditions in the VAA (see Table 5.23).

Confidence The Authors' confidence that reasonable logic and/or data support scaling is MEDIUM for all subclasses.

Variable: SNAGS (V_{SNAG})

Table 5.23 Mean, standard deviation, and ranges for snag density and basal area for all three subclasses

Disturbance Gradient	Sample Size	Snag Basal Area (Mean, SD, Range)	
Unaltered / Reference Standard	4	31 $\pm$ 31	(0 to 68)
Minimally Altered	13	21 $\pm$ 26	(0 to 67)
Moderately Altered	18	120 $\pm$ 3006	(0 to 1216)
Extensively Altered	20	39 $\pm$ 94	(0 to 319)
Unrecoverable	2	0	

Scaling for High, Moderate, and Low Gradient Subclasses

MEASUREMENT CONDITION FOR V_{SNAG}	INDEX
a. Snag basal area $\geq$ 40 but $\leq$ 80 ft^2/acre **and** b Tree mortality resulting in snag formation is not due to human activities.	1.00
a Snag basal area $\geq$ 10 but < 40 ft^2/acre **and** b Tree mortality resulting in snag formation is not due to human activities.	0.75
a Snag basal area $\geq$ 10 but < 40 ft^2/acre **or** > 150 ft^2/acre **and** b Tree mortality resulting in snag formation is due to human activities (*e.g.*, groundwater extraction, herbicide drift, water impoundments, girdling, site preparation for crop production/development, *etc.*)	0.50
a Snag basal area < 10 but > 0 ft^2/acre **or** > 300 ft^2/acre **and** b Tree mortality resulting in snag formation is due to human activities (*e.g.*, groundwater extraction, water impoundments, girdling, site preparation for crop production/development, *etc.*)	0.25
a Snag basal area is 0 ft^2/acre **and** b The variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, golf course, orchard, park, *etc.*) is discontinued and no restoration measures are applied.	0.10
a Snag basal area is 0 ft^2/acre **and** b The variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, water impoundment, concrete structures, roads, parking lots, *etc.*) is discontinued and no restoration measures are applied.	0.00

SOIL PROFILE INTEGRITY ($V_{SOILINT}$)

Definition

Soil Profile Integrity is a measure of the presence and condition of representative soil profiles (soil horizons) within the VAA.

Rationale for Selection of Variable

The integrity of the soil profile, through linkages with site hydrology, exerts strong control on the ecosystem functions that occur in High, Moderate and Low gradient riverine waters/wetlands in SCSBC. These functions include biogeochemical processes affecting nutrient cycles and storage, and the establishment and maintenance of plant communities. In particular, finer textured soils that occur within the Low gradient subclass are rare, given past and current land uses. Where they occur, they exhibit increased profile development, structure, and organic carbon accumulation. Thus, when compared to the sandy skeletal soils that are characteristic of the High and Moderate gradient subclasses, the finer textured soils in Low gradient landscape positions have higher cation exchange and assimilative capacities.

Maintenance of intact soils in Low gradient riverine waters/wetland is especially important in the SCSBC landscape, because water movement through Low gradient sites exhibits lower kinetic energy and longer residence time when compared to High and Moderate gradient subclasses (*i.e.* diminished infiltration rates and hydraulic conductivities). Increased time of contact of water with soil mineral particles and organic matter, plant roots, microbes, *etc.*, facilitates retention and transformation of nutrients, organic matter and contaminants. These soil processes are critically important to the maintenance of water quality.

Measurement Protocol

The VAA for $V_{SOILINT}$ consists of a transect that runs from the outer edge of the Santa Barbara County required buffer or setback on stream left to the outer edge of the required buffer or setback on stream right (Figure 5.17). To develop a meassure for $V_{SOILINT,}$ excavate a series of soil pits along the VAA transect. The objective of your sampling is to examine the structure and condition of soils that are *representative* of the riparian ecosystem (a) in the channel area, (b) above OHW and below top-of-bank (TOB), and (c) in the Santa Barbara County required buffers or setbacks. Therefore, at a minimum, excavate pits or exploratory holes in these three areas.

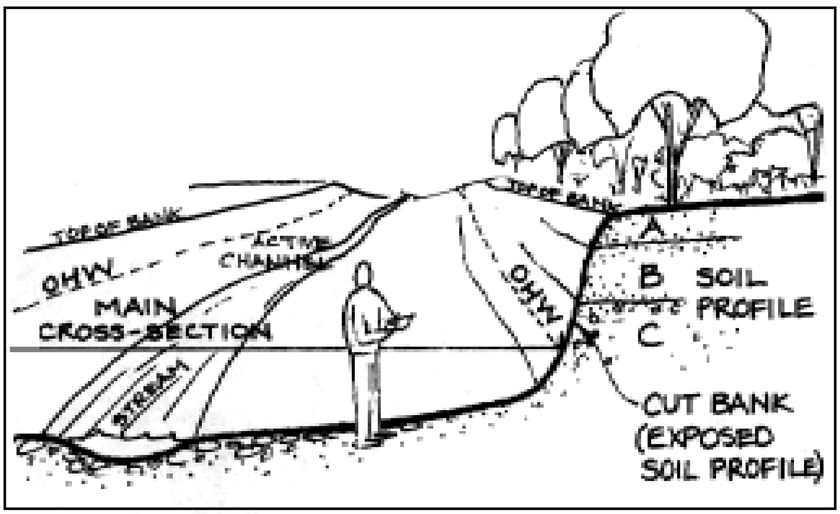
In each pit, look for evidence of fill activities, earthwork, hardening, mechanical damage (*e.g.*, compaction), etc. Pay particular attention to present and potential interactions of VAA soils with water at (a) observed flow conditions, (b) base flow conditions, and (c) storm flow conditions. Integrate your observations of soil conditions within the VAA to deveop a view of *representative* soil conditions in the riparian zone. Excavate soil pits to a depth of approximately 3 ft or to the depth of impenetrable debris (*e.g.,* boulders, stones, cobbles) or excess water, whichever is encountered first. A closed-bucket or

Variable: SOIL PROFILE INTEGRITY ($V_{SOILINT}$)

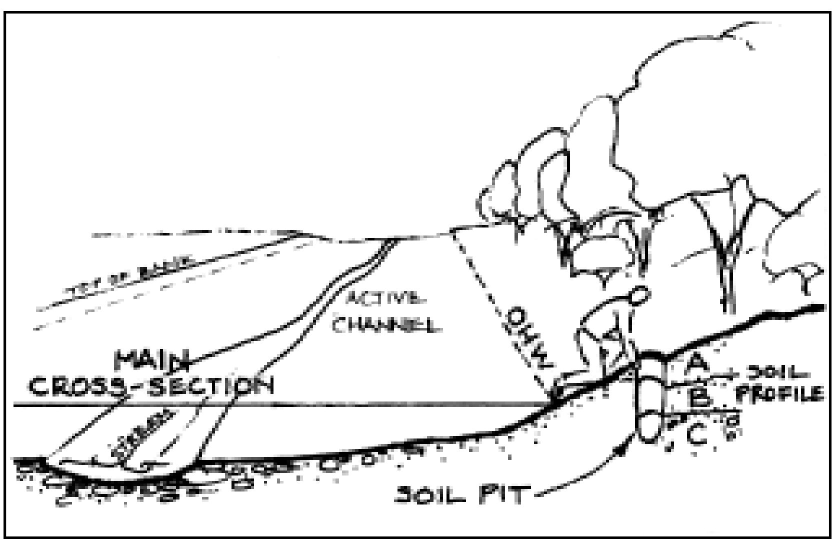
Dutch auger may be useful below approximately 2 ft. If available, examine relatively undisturbed portions of road cuts, cutbanks associated with stream channels, excavations, *etc.* to augment soil pit information. Identification, nomenclature, and description of soil horizons should be consistent with guidance provided by the USDA Natural Resource Conservation Service (SCS 1962; NRCS 1998). All soil depths are measured from the soil surface (usually an A) horizon, excluding any litter or duff layers that may have accumulated on the soil surface (see Figure 5.17). Live vascular and non-vascular plant materials are **not** included in measurements of soil depths. Determine Soil colors consistent with a Munsell Soil Color Chart (Munsell 1992).

Figure 5.17 Measurement protocol for the soil profile integrity variable ($V_{SOILINT}$)

a.
Describe the riparian soil profile at the main transect using the stream cut bank.



b.
If there is no obvious cut bank showing the soil profile, dig a representative soil pit within the riparian zone. Describe riparian soil profile.



Variable: SOIL PROFILE INTEGRITY ($V_{SOILINT}$)

Scaling Rationale The Authors used best scientific judgment and, secondarily, empirical field data from 60 project sites to scale this variable. For the Low gradient subclass, soil profiles are generally loamy or finer in texture, with the presence of a developed A and Bw horizons, and the accumulation of organic carbon (*i.e.,* a value and chroma within the upper part of the profile less than 3). Redoximorphic features and hydric soils are often present. Organic carbon accumulation, finer textured soil, structure, and horizon development may be absent, diminished, or buried in degraded sites.

For High and Moderate gradient subclasses, soil textures range from loamy sand to sandy loams and are dominantly skeletal (>35% coarse fragments such as gravels, cobbles, stones). Profile development is generally weak to absent and organic carbon accumulation is minimal.

The scaling presented herein is based on the presence, condition, and color (organic carbon content) of organic and/or mineral horizons and the degree of disruption that has occurred from direct manipulation of the riparian areas, streambed, and/or stream bank(s) (*e.g.*, rip-rap, revetments, fenced cobble and stone banks, or concrete trapezoids). For all subclasses, the soil profile integrity variable is scaled down proportional to the degree of anthropogenic disturbance or disruption of the soil profile.

Confidence The Authors' confidence that reasonable logic and/or data support scaling is MEDIUM for all subclasses.

Variable: SOIL PROFILE INTEGRITY ($V_{SOILINT}$)

Scaling for High and Moderate Gradient Subclasses

MEASUREMENT OR CONDITION FOR $V_{SOILINT}$	INDEX
a. Representative VAA soil profile is weakly to moderately developed (*i.e.,* different horizons are discernable), intact and entirely undisturbed by human activities (*e.g,.* roads, debris basins, agriculture). Typically the soil profile has a weakly developed A, and in some cases a weak Bw horizon, some structure within the upper part, and a moist color value, **and** b. Chroma ≤ 3 in the upper part. The soil particle size class is generally loamy skeletal or sandy skeletal.	1.00
a. Representative VA A soil profile is intact and currently undisturbed by human activities, **but** b. Disturbances have occurred in the VAA, which at some point in time may have affect the integrity or stability of the soil profile (*i.e.,* may diminish organic carbon content, soil surface structure, infiltration, structural integrity of the channel bank, or lead to erosion).	0.75
Representative VA A soil profile is: a. Present but perturbed by human activities, (*e.g*, diminished structure, thickness, infiltration, and/or organic carbon content), **and** b. The soil profile is generally intact (*i.e*., soil horizons can still be distinguished; no horizons are completely removed)	0.50
a. Representative VA A soil profile is no longer entirely present (intact) and is perturbed by human activities. The surface horizon is removed or buried by human activities **and** b. Subsurface horizon(s) are either buried or exposed (*e.g.,* disturbance by roads, rip-rap, debris basins, construction,), and are subject to continued deterioration as a result of human activities, **and** c. Soil structure is weak or absent and organic carbon content is diminished (*e.g.* moist value and chroma > 3 and little to no root biomass).	0.25
Representative VA A Soil Profile is no longer entirely present or intact. Specifically: a. The surface horizon is removed by human activities and the subsurface horizon(s) are exposed, highly eroded, and subject to failure or continued erosion and deterioration as a result of human activities (*e.g.*, disturbance by roads, construction, or agriculture), **and** b. Soil structure at the current soil surface is weak or absent and organic carbon content is greatly diminished or absent (*e.g.*, moist value <u>and</u> chroma >> 3, little to no root biomass), **and** c. The soil profile is recoverable and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
Representative VA A soil profile is no longer present (*i.e.*, is unrecognizable) as a result of human activities and disturbances. Specifically: a. The surface and subsurface horizons are generally absent due to removal **or** burial as a result of human activities (*e.g.* the placement of fill, roads, construction, debris basins, revetments, concrete weirs or trapezoids), **and** b. Soil structure is absent, organic carbon content is low or absent (*e.g.* moist value and chroma >>3, no root biomass), **and** c. The soil profile is neither recoverable nor sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

Variable: SOIL PROFILE INTEGRITY ($V_{SOILINT}$)

Scaling for the Low Gradient Subclass

MEASUREMENT OR CONDITION FOR $V_{SOILINT}$	INDEX
a. Representative VAA soil profile is weakly to strongly developed (*i.e.* different horizons are discernable), entirely intact and entirely undisturbed by human activities (*e.g.* roads, construction, agriculture). Typically the soil profile has an A, Bw or Bg, and/or C or Cg horizon(s) and a moist color value **and** b. chroma $\geq$ 3 in the upper part. A soil particle size class of loamy (or finer) is often present.	1.00
a. Representative VA A soil profile is entirely intact and currently undisturbed by human activities, **but** b. Disturbances have occurred in the VAA, which at some point in time may affect the integrity of the soil profile (*i.e.*, may diminish organic carbon content, soil surface structure, infiltration, structural integrity of the channel bank, or lead to erosion).	0.75
Representative VA A soil profile is: a. Present but perturbed by human activities (*e.g.*, diminished structure, thickness, infiltration, and/or organic carbon content) **and** b. Soil horizons are generally intact (*i.e.*, soil horizons can still be distinguished; no horizons are completely removed).	0.50
a. Representative VA A soil profile is no longer entirely present (intact) and is disturbed by human activities. The surface horizon is removed or buried by human activities **and** b. Subsurface horizons are either buried or exposed (*e.g.,* disturbance by roads, construction, agriculture) and are subject to continued deterioration as a result of human activities **and** c. Surface soil structure is weak or absent and organic carbon content is diminished (*e.g.,* moist value and chroma > 3 and little to no root biomass).	0.25
Representative VA A soil profile is no longer entirely present or intact: a. The surface horizon is removed by human activities and the subsurface horizon(s) are exposed, highly eroded, and subject to failure or continued erosion and deterioration as a result of human activities (*e.g.,* disturbance by roads, construction, or agriculture), **and** b. Soil structure is weak or absent and organic carbon content is greatly diminished or absent (*e.g.*, moist value and chroma much >3, little to no root biomass), **and** c. The soil profile is recoverable and sustainable through natural processes if the existing land use is discontinued and no restoration measures are applied.	0.10
a. Representative VA A soil profile is no longer present (*i.e.*, is unrecognizable) as a result of human activities and disturbances. The surface and subsurface horizons are generally absent due to removal **or** burial as a result of human activities (*e.g.,* the placement of fill, roads, rip-rap, revetments, concrete weirs or trapezoids) **and** b. Soil structure is absent, organic carbon content is low or absent (*e.g.,* moist value and chroma > 3, no root biomass) **and** c. The soil profile is neither recoverable nor sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

VEGETATIVE STRATA (V_{STRATA})

Definition

Vegetative Strata is the number of distinct vegetation layers present within the VAA. Vegetation strata were defined as follows: trees (single stem woody species with >3" DBH and > 10 ft tall); shrubs (multiple stem woody species); vines or lianas (woody vines); and herbs, including forbs, graminoids, ferns, and fern allies.

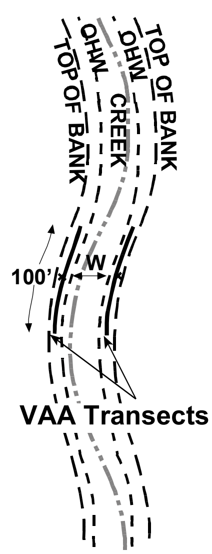
Rationale for Selection of the Variable

Multiple vegetation strata (*e.g.*, tree and shrub layers) often are good indicators of the development and maintenance of plant communities, habitat structure, and channel bank stability (Tilman 1994). For example, the number of strata can be correlated with the habitat structure and complexity necessary to support characteristic faunal assemblages, *e.g.*, those typical of the SCSBC. Similarly, the number and types of vegetation strata combine to provide the diversity of faunal habitat, as well as the types and quantity of food and cover resources available.

For the High and Moderate gradient subclasses, multiple strata are, among others, reasonable indicators of reference standard conditions. In the Low gradient coastal surface subclass, a single vegetation stratum, on average, is characteristic of reference standard conditions.

Measurement Protocol

V_{STRATA}



The VAA for V_{STRATA} consists of a 100-foot reach of the two vegetative transects on stream right and stream left. The 100-foot transects should be centered at the identified midpoints proximate to the PAA cross section. To develop a measure for V_{STRATA}, begin 40 feet downstream from the midpoint of the vegetative traansects on stream right. Begin walking upstream along the transect, stopping at every 10 foot interval. At each 10-foot interval, look for vegetation on the ground as well as directly above the stopping point. Record the total number of strata (*i.e.*, herb,vine, shrub, and tree) that intersects the transect at each stopping point. For example, an HGM user identifies the presence of only the herb stratum at a given sampling point. They would therefore record one stratum as present. Make this measurement at 10 points along the vegetation transect, and then repeat this process on stream left. Record all results on the Minimum Submittal Worksheet provided in Chapter 7. Using the 20 observations, calculate the average number of vegetation strata for the VAA. Round this average to the nearest whole number.

Variable: VEGETATIVE STRATA (V_{STRATA})

Data Located in Appendix B-33 through B-60

Scaling Rationale The Authors scaled V_{STRATA} using reference data (see Table 5.24 below), field observations, and best scientific judgment. The literature supports the logic that multiple vegetation strata operate in concert with other structural features of riverine ecosystems, which together lead to greater faunal habitat stability, habitat complexity, increased channel bank stability, *etc.* Therefore, the presence of multiple vegetation strata (*i.e.*, >2) in riverine waters/wetlands of the SCSBC will result in a higher FCI. Fewer strata will result in a lower FCI due to the lack of habitat structure, habitat complexity, channel bank stability, *etc.*

Table 5.24 Mean, standard deviation, and ranges the average number of strata for High, Moderate and Low gradient subclasses

Disturbance Gradient	Sample Size	Average Number of Strata (Mean, SD, Range)	
Unaltered / Reference Standard	4	1.81 ± 0.23	(1.65 to 2.15)
Minimally Altered	13	1.90 ± 0.36	(1.55 to 2.35)
Moderately Altered	18	1.99 ± 0.46	(1.20 to 2.65)
Extensively Altered	20	1.49 ± 0.52	(0.50 to 2.60)
Unrecoverable	2	0.70 + 0.92	(0.05 to 1.35)

Variable: VEGETATIVE STRATA (V_{STRATA})

Scaling for High, Moderate, and Low gradient subclasses

MEASUREMENT CONDITION FOR V_{STRATA}	INDEX
a. Average number of strata ≥ 2.0 **and** b. Vegetation below top of bank is unaltered by human activities.	1.00
a. Average number of strata ≥ 2.0 **and** b. Vegetation below top of bank is moderately altered by human activities (*e.g.*, partial clearing of the the vegetation by grazing of domestic livestock, or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc*.).	0.75
a. Average number of strata is < 2.0 but ≥ 1 **and** b. Vegetation below top of bank is moderately altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, crop production, undeveloped parks, urban/suburban development, flood control access, *etc*.).	0.50
a. Average number of strata is < 2.0 but ≥ 1 **and** b. Vegetation below top of bank is extensively altered by human activities (*e.g*., extensive clearing of the begetation by grazing of domestic livestock, crop production, developed parks, urban/suburban development, flood control access, highway right of way and maintenance, *etc*)	0.25
The average number of strata < 1.0. The variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
The average number of strata < 1.0. The variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

Confidence The Authors' confidence that reasonable logic and/or data support scaling is MEDIUM for the High and Moderate Gradient subclasses and LOW for the Low gradient subclass.

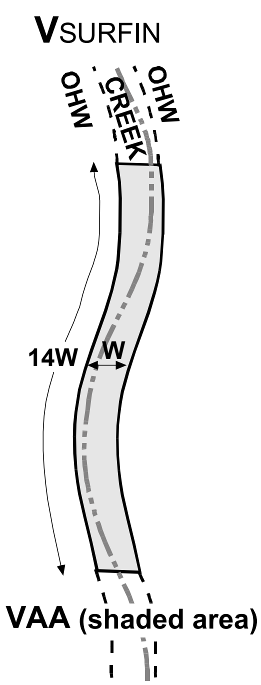
SURFACE WATER IN (V_{SURFIN})

Definition

SurfaceWater In refers to the hydrologic connections into the VAA from the adjacent landscape.

Rationale for Selection of the Variable

The type and number of surface water connections between riverine ecosystems and their surrounding landscape are good field indicators of the potential for the riverine ecosystem to maintain intact hydrologic, geochemical, plant community, and faunal support/habitat functions (Brinson *et al* 1995). For example, intact surface water connections facilitate surface water runoff from surrounding landscapes. Such runoff is necessary to maintain main channel sediment processes and characteristic cross sectional and longitudinal channel geometries. Similarly, surface water connections are vital in allowing biogeochemical processes associated with particulate retention, elemental cycling, and organic carbon export (both dissolved and particulate) to occur.



Intact surface water connections help to maintain diverse native plant communities in riparian ecosystems. They provide relatively moist microsites that are transitional habitats among (relatively wet) main channel/riparian and (relatively dry) upland habitats. The relatively moist transitional sites associated with surface water connections (a) support complex tree canopies and understory structure, (b) contribute significantly to plant species diversity in riparian ecosystems, and (c) act as corridors for dispersal of plant propagules within the between components of the riparian ecosystem.

Intact surface water connections within the relatively undisturbed riparian ecosystems of SCSBC also provide important links between aquatic and terrestrial habitats for a wide range of aquatic and semi-aquatic faunal species. Specifically, intact surface water connections allow riparian dependent animals (*e.g.,* Steelhead trout, salamanders, and newts) to move within riparian ecosystems, and thus to complete life cycle requirements. Surface water connections also provide escape, hiding, resting and reproductive cover for aquatic and terrestrial animals that use all or parts of riparian ecosystems as habitat.

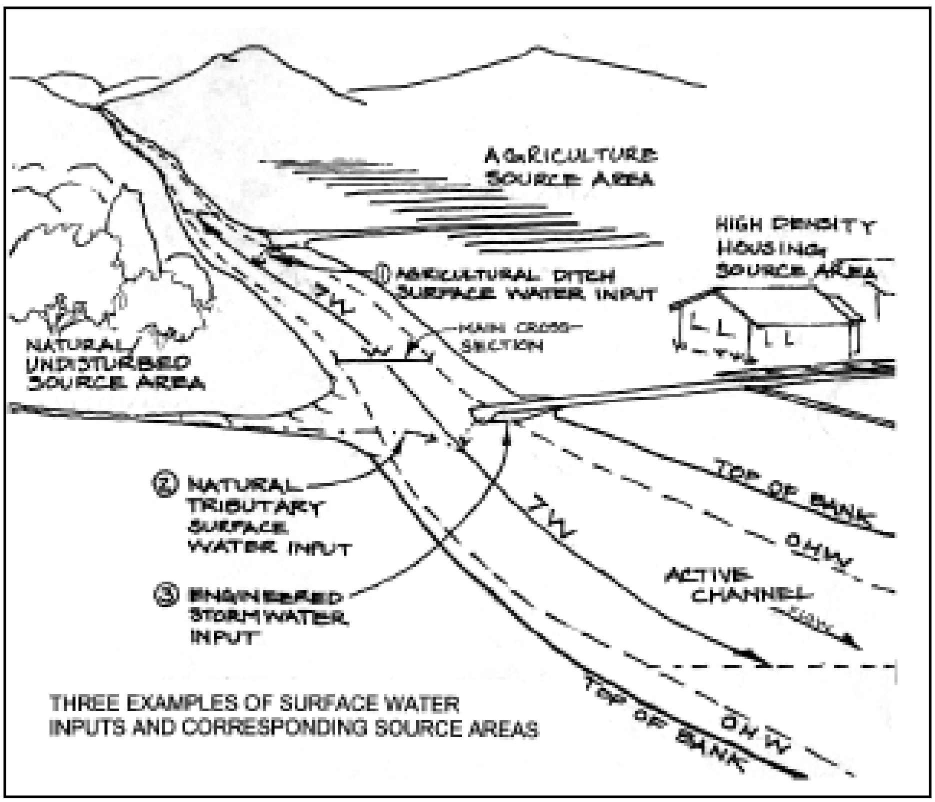
Measurement Protocol

The VAA for V_{SURFIN} consists of two transects: one upstream and one downstream. These transects originate at the PAA cross section. Their length is seven times the OHW cross section width. Thus you will travel a total distance of fourteen times the OHW cross section width (*i.e.*, 7 OHW cross section widths upstream and 7 OHW cross section widths downstream). The width of the VAA is the channel system width below OHW (Figure 5.18). To develop measurements for V_{SURFIN}, examine air photos and maps that will offer information pertaining to the condition of the source areas for surface water connections to the VAA. Then, start at the main cross section. Walk the upstream and downstream legs of the VAA and identify the number and type of all permanent,

Variable: SURFACE WATER IN (V_{SURFIN})

seasonal, and ephemeral surface water connections that run across the OHW level and into the stream channel from surrounding landscape position. Characterize the condition of the source area landscape as being realtively natural/ undisturbed, low, moderate or high density housing, malls, parking lots, industrial, etc. Examples of surface water connections into stream channels throughout the SCBC range from being natural tributaries to agricultural ditches to constructed stormwater inputs to highly engineered and hardened water diversion structures. Record results on the Minimal Submittal Worksheet provided in Chapter 7.

Figure 5.18 Measurement protocol for the surface water input variable (V_{SURFIN})

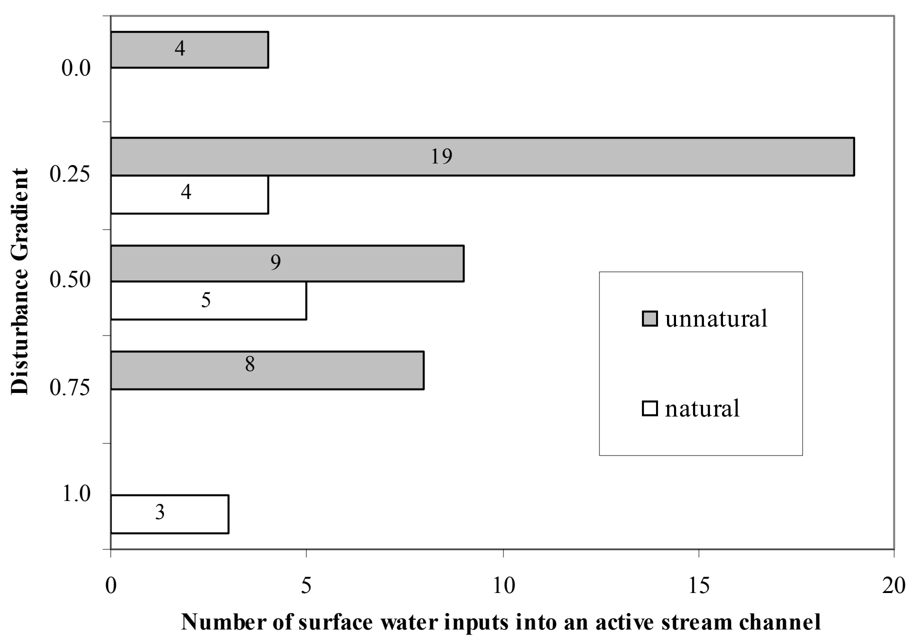


Data Located in Appendix B-1through B-12

Variable: SURFACE WATER IN (V_{SURFIN})

Scaling Rationale The Authors scaled V_{SURFIN} using a combination of reference data, field observations, and best scientific judgment. The Authors grouped High, Moderate, and Low gradient subclasses based on similarities in the reference system data. The Authors combined data with the Authors' field observations of relatively consistent trends in the effects of human activities to V_{SURFIN} conditions throughout the reference domain. Specifically, the Authors scaled this variable based on the assumptions that (a) no human alteration of V_{SURFIN} conditions represents reference standard conditions (1.0), and (b) increasing levels of human disturbance tend to decrease the number and change the type/complexity of surface connections (Figure 5.19). Elimination of V_{SURFIN} connections via redirection of flows to other channel systems or capture and piping of surface flows to storm or sewer systems represents an irreversible endpoint (0.0).

Figure 5.19 Number of natural and unnatural surface inputs into active stream channels for all subclasses across a disturbance gradient



Confidence The Authors' confidence that reasonable logic and/or data support scaling is HIGH for all subclasses.

Variable: SURFACE WATER IN (V_{SURFIN})

Scaling for High, Moderate, and Low Gradient Subclasses

MEASUREMENT CONDITION FOR V_{SURFIN}	INDEX
Surface hydraulic connections into the VAA from the adjacent landscape are unaltered by human activities. No manipulations of the surface hydraulic connections leading to, or within the VAA are present.	1.00
Limited alteration of the natural surface hydraulic connections evident (*e.g.,* fire and farm road crossings; agricultural or very low density (1 house/100 acres) residential runoff directed to natural, ungraded tributaries via light grading).	0.75
Surface hydraulic connections into the VAA from the adjacent landscape have been: a Altered by human activity (*e.g.,* low gradient slope agricultural ditches or swales; inputs from low (1 house/10 acres) to moderate (1 house/5 acres) density residential areas or open space parks or urban inputs), **and** b Achieved through a combination of natural tributaries and non-hardened engineered structures (*e.g.,* through unlined ditches or swales with or without culvert outfalls), and/or via engineered structures delivering treated stormwater.	0.50
Surface hydraulic connectionsinto the VAA are: a Altered by moderate to intense human activity, **and** b Achieved primarily through hardened engineered structures (*e.g.,* culverts with headwalls, buried pipes, lined ditches, sheet flow over concrete or asphalt) that convey flow from areas of moderate density residential (*i.e.,* 1 house/five acres), service industry installations (*e.g.,* < 2 acre malls, parking lots, *etc.*) and/or high intensity agriculture (e.g., annual row crops, orchard production on slopes > 15%).	0.25
Surface hydraulic connections into the VAA from the adjacent landscape have been: a Significantly altered by human activity such as high density suburban, urban or industrial inputs, or high intensity agricultural (*e.g.*, annual row crops, orchard production on slopes >15%) **and** b Achieved through hardened engineered structures that drain runoff from urban, large industrial, or high intensity agricultural portions of the landscape proximate to the VAA; **and** c The variable is **somewhat recoverable** to reference standard conditions and sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.10
Surface hydraulic connections into the VAA from adjacent portions of the landscape have been: a Significantly altered by human activity (*e.g.,* agricultural, high density urban or industrial inputs); **and** b Achieved through hardened engineered structures that drain runoff from urban or large industrial, or high intensity agricultural (e.g., annual row crops; orchard production on slopes >15%) portions of the landscape proximate to the VAA. These structures could not be removed without extensive re-engineering to address substantial threats to public safety, **therefore** c The variable is not recoverable to reference standard conditions and not sustainable through natural processes, if the existing land use is discontinued and no restoration measures are applied.	0.00

BASAL AREA OF TREES (V_{TREEBA})

Definition

Basal Area of Trees is the cross sectional area of trees (single stem woody species with >3" DBH and > 10 ft tall) within the VAA.

Rationale for Selection Of the Variable

In forested ecosystems, the basal area of trees is a standard measure of dominance (Curtis 1959, Avery 1967, and Mueller Dombois and Ellenberg 1974). Recognition of the relative dominance of the tree strata in forested communities is important because trees in several stages of succession regulate microclimatic conditions that affect terrestrial vegetation community development, and conditions in the aquatic environment (*e.g.*, stream temperature). In addition, tree canopies and root structures help to protect riparian sites from erosion due, for example, to raindrop energy or high energy surface flows. Trees provide horizontal and vertical structure that, in turn, present (a) opportunities for the movement of animals into and out of riparian ecosystems and (b) several forms of cover (*e.g.,* resting , hiding, escape, thermal). Trees produce detritus that is incorporated into the soil profile, and into aquatic food webs.

Measurement Protocol

The VAA for V_{TREEBA} is the area surrounding the plot centers for the circular vegetative sample plots proximate to the PAA cross section on stream right and stream left. To develop a measure for $V_{TREEBA,}$ begin at the plot center for the circular vegetative sample plots proximate to the PAA cross section on stream right and stream left. At each of the plot centers, use a standard plotless cruise with a basal area factor (BAF) 10 prism or angle gauge (see Figure 5.16) to determine estimates for the average tree basal area per acre. Remember that a tree has been defined as single stemmed woody vegetation that is greater than 3" DBH and taller than 10 feet. Protocols for BAF 10 plotless cruises are summarized in Avery 1967 and Appendix E. Record results on the Minimum Submittal Worksheet provided in Chapter 7. Average the basal area estimates for the two plots (stream right and stream left) to calculate the final estimate of tree basal area per acre.

Variable: BASAL AREA OF TREES (V_{TREEBA})

In the absence of a BAF 10 prism or angle gauge, establish a fixed area plot (*e.g.,* 1/10 acre circular plot [radius 37.3 ft]) and measure the diameter at breast height (DBH) of each tree within the sample plot. Convert all DBH measurements to basal area using the following series of equations (Steps 1 through 4) for the area of a circle. Sum all the estimates to develop an approximation of stand basal area, and then convert the stand basal area measurement to a per acre basis. See example below for the necessary calculations.

Step 1. Sum all basal area measurements recorded in your fixed area plot.
e.g., 5″ + 5″ + 3″ + 10″ + 8″ = 31″
Step 2. Convert inches to feet
e.g., (31 inches) * (1 foot / 12 inches) = 2.58 ft
Step 3. Calculate area
e.g., $\Pi * r^2 = \Pi * (2.58 \text{ ft} / 2)^2 = \Pi * 1.66 = 5.23 \text{ ft}^2$
Step 4. Calculate basal area on a per acre basis
e.g., $(5.23 \text{ ft}^2) / (1/10 \text{ acre}) = 52.3 \text{ ft}^2 / \text{acre}$

Data Located in Appendix B-33 through B-60

Scaling Rationale The Authors scaled V_{TREEBA} using reference data, field observations, and best scientific judgment. Throughout the reference domain and within all three subclasses, the Authors observed that tree basal area varied, at least one order of magnitude, either naturally or as a result of human intervention. Additionally, reference system data (Table 5.25, 5.26, and 5.27 below) indicate that tree basal area varies more widely at higher elevations (within the High gradient subclass) than within Moderate or Low gradient subclasses. This variation is a function of such site-specific phenomena as site water balance conditions, land use history, successional stage, *etc.* Human alterations of riparian ecosystems in the SCSBC usually have resulted in a decrease in the basal area of trees through land clearing for residential or commercial developments, debris basins, livestock grazing, and so forth. However in some instances, human intervention can increase basal area (*e.g.,* planting of eucalyptus, avocados).

Variable: BASAL AREA OF TREES (V_{TREEBA})

Table 5.25 Mean, standard deviation, and range of total tree basal area for the High gradient subclass

Disturbance Gradient	Sample Size	Total Tree Basal Area (Mean, SD, Range)	
Unaltered / Reference Standard	3	121.7 ± 43.7	(85 to 170)
Minimally Altered	2	97.5 ± 45.9	(65 to 130)
Moderately Altered	0	N/A	
Extensively Altered	0	N/A	
Unrecoverable	0	N/A	

Table 5.26 Mean, standard deviation, and range of total tree basal area for the Moderate gradient subclass

Disturbance Gradient	Sample Size	Total Tree Basal Area (Mean, SD, Range)	
Unaltered / Reference Standard	1	90	
Minimally Altered	8	138 ± 98	(0 to 300)
Moderately Altered	16	98 ± 41	(30 to 140)
Extensively Altered	8	83 ± 76	(0 to 240)
Unrecoverable	0	N/A	

Table 5.27 Mean, standard deviation and range of total tree basal area for Low gradient subclass

Disturbance Gradient	Sample Size	Total Tree Basal Area (Mean, SD, Range)	
Unaltered / Reference Standard	0	N A	
Minimally Altered	2	50 ± 35.4	(25 to 75)
Moderately Altered	3	35 ± 13	(25 to 50)
Extensively Altered	12	17.5 ± 15.5	(0 to 40)
Unrecoverable	2	25 ± 35.4	(0 to 50)

Variable: BASAL AREA OF TREES (V_{TREEBA})

Scaling for the High gradient subclass

MEASUREMENT CONDITION FOR V_{TREEBA}	INDEX
a. Tree basal area ≥ 100 ft^2/acre, **and** b. Vegetation below top of bank is unaltered by human activity.	1.00
a. Tree basal area ≥ 100 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* partial clearing of the vegetation by grazing of domestic livestock, or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc.*)	0.75
a. Tree basal area ≥ 65 ft^2/acre but <100 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* partial clearing of the vegetation by grazing of domestic livestock, or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc.*)	0.50
a. Tree basal area ≥ 35 ft^2/acre but < 65 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* extensive clearing of the vegetation by grazing of domestic livestock, crop production, developed parks, urban/suburban development, flood control access, *etc.*)	0.25
a. Tree basal area < 35 ft^2/acre, **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied .	0.10
a. Tree basal area < 35 ft^2/acre, **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.,* concrete ditch, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied .	0.00

Variable: BASAL AREA OF TREES (V_{TREEBA})

Scaling for the Moderate gradient subclass

MEASUREMENT CONDITION FOR V_{TREEBA}	INDEX
a. Tree basal area ≥ 70 ft^2/acre, **and** b. Vegetation below top of bank is unaltered by human activity.	1.00
a. Tree basal area ≥ 70 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* crop production, parks, urban/suburban development, *etc.*)	0.75
a. Tree basal area ≥ 35 ft^2/acre but < 70 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* partial clearing of the vegetation by grazing of domestic livestock, or by clearing for crop production, parks, urban/suburban development, flood control access, *etc.*)	0.50
a. Tree basal area ≥ 10 ft^2/acre but < 35 ft^2/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, extensive clearing of the vegetation by grazing of domestic livestock, crop production, parks, urban/suburban development, flood control access, *etc.*)	0.25
a. Tree basal area < 10 ft^2/acre, **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Tree basal area < 10 ft^2/acre , **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

Variable: BASAL AREA OF TREES (V_{TREEBA})

Scaling for the Low gradient subclass

MEASUREMENT CONDITION FOR V_{TREEBA}	INDEX
a. Tree basal area $\geq$ 50 ft²/acre, **and** b. Vegetation below top of bank is unaltered by human activity.	1.00
a. Tree basal area $\geq$ 50 ft²/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock, or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc.*)	0.75
a. Tree basal area $\geq$ 25 ft²/acre but <50 ft²/acre, **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of the vegetation by grazing of domestic livestock or by clearing for crop production, undeveloped parks, urban/suburban development, flood control access, *etc.*)	0.50
a. Tree basal area $\geq$ 5 ft²/acre but < 25 ft²/acre , **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* extensive clearing of the vegetation by grazing of domestic livestock, crop production, developed parks, urban/suburban development, flood control access, *etc.*)	0.25
a. Tree basal area < 5 ft²/acre. **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Tree basal area < 5 ft²/acre, **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete ditch, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

Confidence The Authors' confidence that reasonable logic and/or data support scaling is MEDIUM for all subclasses.

TREE CANOPY COVER (V_{TREECC})

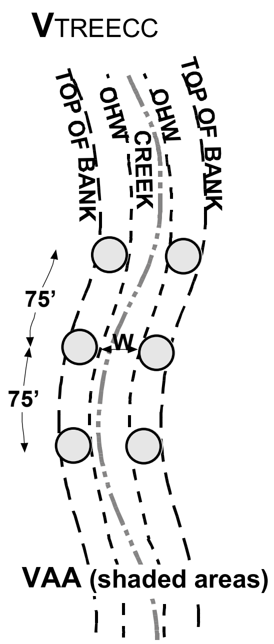
Definition

Tree Canopy Cover is the percent canopy cover of trees (single stem woody species with >3” DBH and > 10 ft tall).

Rationale for Selection of the Variable

Tree canopy coverage is traditionally used as a measure of species distribution and biomass (Clements 1916; Avery 1967; Mueller-Dombois and Ellenberg 1974). As such, canopy cover can indicate the potential for a site to support characteristic ecosystem processes such as maintenance of native and non-native plant communities and faunal habitat. Trees contribute to roughness and topographic variation on floodplain and channel sites. Roughness provides a mechanism that slows water flows and thus provides static and dynamic storage of flood flows and cover for aquatic and terrestrial fauna. Trees maintain channel morphology by increasing bank shear strength through the production and maintenance of fine root biomass. Trees also function as structural elements that limit and/or control development and maintenance of channel geometry.

Trees provide allochotonous inputs of labile and refractory organic carbon to riverine ecosystems. In addition, the presence of tree boles and canopies alter micro-climatic conditions in riparian forests (*e.g.*, moisture, nutrients, light, temperature, wind speed *etc.*). Microclimatic alterations caused by the presence of trees is important in maintaining several ecosystem functions such as biomass production, maintenance of site water balance, nutrient conservation, habitat structure *etc.* Furthermore, trees are instrumental in soil genesis, elemental cycling, and successional processes (Hooper and Vitousek 1997). These successional processes include the dispersal and establishment of plant propagules, support plant and animal species diversity and turnover (Tilman 1982, Huston and Smith 1987, Cohen and Levin 1991, and Tilman and Pacala 1993).



Measurement Protocol

The VAA for V_{TREECC} consists of six 0.1-acre circular plots (radius = 37.3 feet) established along the two vegetation transects, located on stream right and stream left. To measure $V_{TREECC,}$ utilize the six plot centers on the two vegetative transects, stream right and stream left, to define 0.1-acre (radius 37.3 feet) circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent cover for the tree stratum (see Figure 5.10) using midpoints of standard canopy cover classes (Appendix E.6). Record these estimates of percent cover on the Minimum Submittal Worksheet provided in Chapter 7. Average the six measurements to produce a final estimate of percent canopy cover for the tree stratum.

Data

Located in Appendix B-33 through B-60

Variable: TREE CANOPY COVER (V_{TREECC})

Scaling Rationale

The Authors scaled V_{TREECC} using reference data, field observations, and best scientific judgment. Specifically, reference data for High and Moderate gradient subclasses were grouped according to similarities in plant community structure and degree of perturbation. Within the two V_{TREECC} scales, ranges of canopy coverage were identified to incorporate the natural range of variation within forested riparian communities of the SCSBC (Table 5.27). Sites dominated by non-native trees (*e.g.,* avocado) were excluded from the scaling.

Some of the recorded variation appears to be the result of natural causes (*e.g.*, cyclical droughts, successional processes, *etc.*). Higher canopy cover values are indicative of well established riparian forests. However, some of the higher recorded canopy coverage percentages, particularly within the Low gradient subclass, were due to anthropogenic disturbances that tended to augment or supplant the tree canopy coverage of the natural community found in the lower gradient coastal surface subclass.

Table 5.27 **Mean, standard deviation, and range of percent canopy cover for trees within the High and Moderate gradient subclasses**

Disturbance Gradient	Sample Size	Percent Canopy Cover of Trees (Mean, SD, Range)	
Unaltered / Reference Standard	4	47 ± 37	(0 to 85.5)
Minimally Altered	10	40 ± 25	(0 to 85.5)
Moderately Altered	16	52 ± 26	(10.5 to 85.5)
Extensively Altered	8	29 ± 32	(0 to 85.5)
Unrecoverable	0	N/A	

Table 5.28 **Mean, standard deviation and range of percent canopy cover for trees within the Low gradient subclass**

Disturbance Gradient	Sample Size	Percent Canopy Cover of Trees (Mean, SD, Range)	
Unaltered / Reference Standard	0	N A	
Minimally Altered	2	62 ± 34	(38 to 85.5)
Moderately Altered	3	24 ± 19	(10.5 to 38)
Extensively Altered	12	15 ± 23	(0 to 85.5)
Unrecoverable	2	31 ± 45	(0 to 63)

Variable: TREE CANOPY COVER (V_{TREECC})

Scaling for High and Moderate gradient subclasses

MEASUREMENT CONDITION FOR V_{TREECC}	INDEX
a. Average tree canopy cover $\geq$ 80% **and** b. Vegetation below top of bank is unaltered.	1.00
a. Average tree canopy cover $\geq$ 40% and < 80% **and** b. Vegetation below top of bank is unaltered by human activities.	0.75
a. Average tree canopy cover $\geq$ 40% but < 80% **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of vegetation by grazing of domestic livestock, crop production, parks, urban/suburban development, flood control access, *etc.*)	0.50
Average tree canopy cover $\geq$ 10% but < 40%.	0.25
a. Average tree canopy cover < 10% **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Average tree canopy cover < 10% **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

Variable: TREE CANOPY COVER (V_{TREECC})

Scaling for the Low gradient subclass

MEASUREMENT CONDITION FOR V_{TREECC}	INDEX
a. Average tree canopy cover ≥ 50% **and** b. Vegetation below top of bank is unaltered by human activities.	1.00
a. Average tree canopy cover ≥ 25% and < 50% **and** b. Vegetation below top of bank is unaltered by human activities.	0.75
a. Average tree canopy cover ≥ 25% and < 50% **and** b. Vegetation below top of bank is altered by human activities (*e.g.*, partial clearing of the buffer vegetation by grazing of domestic livestock, crop production, parks, urban/suburban development, flood control access, *etc.*)	0.50
Average tree canopy cover ≥ 5% and < 25%.	0.25
a. Average tree canopy cover < 5% **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, crop production, *etc.*) is discontinued and no restoration measures are applied.	0.10
a. Average tree canopy cover < 5% **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.*, concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

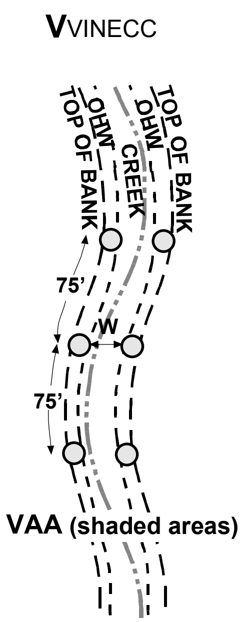
Confidence The Authors' confidence that reasonable logic and/or data support scaling is HIGH for all subclasses.

VINE CANOPY COVER (V_{VINECC})

Definition **Vine Canopy Cover** is the percent canopy cover of vines or lianas (woody vines) within the VAA.

Rationale for Selection of the Variable Vine canopy coverage is one measure of vegetation that indicates maintenance of native plant community structure and function. As such, vine canopy cover can be used along with other measures of vegetative cover to indicate the potential for a site to support characteristic ecosystem processes such as maintenance of native plant communities, fauna and faunal habitat. Vine coverage typical of various stages in the fire/flood/debris flow successional cycles for each subclass indicates natural disturbance dynamics characteristic of riparian plant communities along the SCSBC as well as anthropogenic disturbance dynamics.

Measurement Protocol The VAA for V_{VINECC} consists of six 0.01-acre circular plots (radius = 11.8 feet) established along the two vegetation transects, located on stream right and stream left. To measure $V_{VINECC,}$ utilize the six plot centers on the two vegetative transects, stream right and stream left, to define 0.01-acre (radius 11.8 feet) circular plots. This is best accomplished by stretching a tape from the plot center to the targeted radius, and walking slowly in a circle around the plot center. Within each of the six circular plots, make ocular estimates of the percent cover for all vines (Figure 5.10) using midpoints of standard canopy cover classes (Appendix E.6). Record these estimates of percent cover on the Minimum Submittal Worksheet provided in Chapter 7. Average the six measurements to produce a final estimate of vine canopy coverage.



Data Located in Appendix B-33 through B-60

Variable: VINE CANOPY COVER (V_{VINECC})

Scaling Rationale The Authors scaled V_{VINECC} using reference data, field observations, and best scientific judgment. Specifically, reference data for all three subclasses were grouped according to similarities in plant community structure. Reference data were analyzed to determine average vine cover (by cover class midpoint) for each plot. This provided the Authors with ranges of vine canopy coverage that were used to describe the natural range of variation of vine dominance within forested riparian communities of the SCSBC (Table 5.30). Canopy coverage values for vines exhibited substantial variation within all subclasses, but difference among subclasses did not warrant development of individual scales for each subclass. In general, sites that were either intact without substantial perturbation by humans or late successional, supported comparatively high V_{VINECC} values due to the abundance of native vines. Early successional sites had low vine coverage due to a recent (< 5 years) disturbance and those sites while those sites greatly disturbed by humans tended to exhibit high cover values of non-native vines.

Table 5.30 Mean, standard deviation, and ranges for vine canopy coverage for High, Moderate and Low gradient subclasses

Disturbance Gradient	Sample Size	Vine Canopy Coverage (Mean, SD, Range)	
Unaltered / Near Reference Standard	4	56.75 $\pm$ 12.5	(38 to 64)
Minimally Altered	13	45.5 $\pm$ 31.1	(3 to 85.5)
Moderately Altered	18	41.8 $\pm$ 27.3	(3 to 85.5)
Extensively Altered	20	18.55 $\pm$ 21.7	(0 to 85.5)
Unrecoverable	2	0	

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Scaling for High, Moderate, and Low gradient subclasses

MEASUREMENT CONDITION FOR V_{VINECC}	INDEX
a. Average vine canopy cover $\geq$ 60% and $\leq$ 75% **and** b. Vegetation below top of bank is unaltered by human activities.	1.00
a. Average vine canopy cover $\geq$ 40 % and < 60% **and** b. Vegetation below top of bank is altered by human activities (*e.g.,* partial clearing of the vegetation by grazing of domestic livestock or clearing for crop production, parks, urban/suburban development, flood control access, *etc.*)	0.75
a. Average vine canopy cover $\geq$ 20% but < 40% **or** b. Average vine canopy cover > 75% **and** c. Vegetation below top of bank is altered by human activities (*e.g.,* partial clearing of the vegetation by grazing of domestic livestock or clearing for crop production, parks, urban/suburban development, flood control access, *etc.*)	0.50
a. Average vine canopy cover $\geq$ 5 % but < 20% **or** b. Average vine canopy cover > 75% **and** c. The vegetation below top of bank is extensively altered by human activities (*e.g.*, clearing of the vegetation by grazing of domestic livestock, crop production, parks, urban/suburban development, flood control access, *etc.*)	0.25
a. Average vine canopy cover is < 5% **and** b. Variable is recoverable to reference standard conditions and sustainable through natural processes if the existing land use (*e.g.*, site cleared through heavy grazing of domestic livestock, developed park, and crop production) is discontinued and no restoration measures are applied.	0.10
a. Average vine canopy cover is < 5% **and** b. Variable is neither recoverable nor sustainable to reference standard conditions through natural processes if the existing land use (*e.g.,* concrete trapezoidal channel, parking lot, box culvert, roads, *etc.*) is discontinued and no restoration measures are applied.	0.00

Confidence: The Authors' confidence that reasonable logic and/or data support scaling is HIGH for all subclasses.