
Attachment 1

Mattole River Watershed Analysis

Sub-basin Data

Attachment 2

Mattole River Watershed Analysis

Sediment Budget

Attachment 3

**The Humboldt Redwood Company LLC
(HRC) Prescriptions Based on Watershed
Analysis for Properties owned in the Mattole
River Watershed**

THE HUMBOLDT REDWOOD COMPANY LLC (HRC)

PRESCRIPTIONS

BASED ON WATERSHED ANALYSIS FOR

THE MATTOLE RIVER

6/10/2011

Humboldt Redwood Company LLC applies the following general harvest guidelines across the ownership:

1. Well stocked conifer stands will be managed with an uneven-aged silviculture (i.e. selection/group selection/transition), typically retaining between 1/2 and 2/3 of the pre-harvest basal area. In some instances, harvest may be limited to the removal of individual seed trees provided the stand is well-stocked with conifer upon completion. HRC has discontinued the use of the clearcut silviculture on the ownership.
2. Variable retention (VR) and rehabilitation of understocked area silvicultural methods are used on HRC land as an interim hardwood treatment silviculture targeted specifically for conifer forest restoration. Both of these silvicultures will be applied in a manner that retains 10 to 40 percent of the original stand post harvest while creating sufficient forest openings for the re-establishment of planted and naturally occurring conifers.
3. Cable yarding is used on slopes greater than 40 percent, where feasible, including areas previously tractor yarded, to minimize or avoid unnecessary site disturbance, soil compaction, and increased erosion potential. Ground-based operations are avoided on slopes greater than 40 percent including active or potential unstable areas to the maximum extent feasible. Helicopter harvest may be used where use of conventional yarding methods are not feasible due to difficulty of access.
4. Tractor-constructed skid trails are covered with compacted slash at the discretion and direction of the project forester. Circumstances for this application include locations where potential for erosion and/or sediment delivery to watercourses exist including but not limited to steep grades, locations within or adjacent riparian management zones, and where skid trails connect with roads and landings.
5. Logging slash is treated in a manner which allows for natural and artificial regeneration, minimizes wildfire hazard, minimizes erosion potential, and addresses aesthetic values. Strategic fuel breaks along roads and ridgetops are maintained through the lopping and scattering of slash and/or burning of piles.
6. In addition to selected silvicultural practices, HRC protects forest habitat and cultural values through implementation of an old growth tree retention policy, HCP structural retention requirements including identification and retention of all snags, high value wildlife trees, and down wood, breeding season restrictions, and sustainable forestry practices which constrain harvest both spatially and temporally and increases forest inventory over time. In addition, designated High Conservation Value Forests (HCVF) are managed to further conserve and promote identified cultural and ecological values.
7. HRC's contemporary road system is routinely inspected and maintained to prevent and minimize sediment delivery. Roads no longer required for harvesting (e.g. due to transition from tractor to cable yarding) or other forestry purposes (e.g. wildlife surveys, monitoring, etc.) are decommissioned.

6.3.3.7 Hillslope Management

The hillslope management strategy applies to all portions of HRC's ownership in the Mattole Watershed Analysis Unit, including the Riparian Management Zones (RMZs). The hillslope management prescriptions may be modified in the future as a result of watershed analysis re-visitation. Non-THP related road stormproofing activities required by HCP Section 6.3.3.2 (as revised August 11, 2004) are not restricted by these hillslope prescriptions. In addition, where an existing and approved stormproofing plan exists, road stormproofing, road closure, and road decommissioning of existing roads and road sites on mass-wasting features identified in this section can be conducted without additional geologic review or wildlife agency approval.

The hillslope management strategy utilizes a three-step approach for the identification and avoidance or mitigation of high hazard unstable areas during the planning and implementation of forestry activities, including slope stability training for RPFs; site- and project-specific "screening" for unstable areas; and enforceable site-specific prescriptions applicable to road construction, re-construction, or timber harvest on unstable areas designated as "High hazard":

1. Training

Slope stability training for the identification of unstable areas including the use of the "Hillslope Management Checklist for the Mattole Watershed Analysis Unit".

- a. HRC shall develop a California Licensed Geologist (CLG)-led training course to educate RPFs regarding the general geology, geologic processes, and identification of landscape geomorphology indicative of potentially unstable areas including, but not limited to, inner gorge slopes, headwall swales, debris slide slopes, and earthflows.
- b. The training course shall include instruction regarding implementation of the "Hillslope Management Checklist for the Mattole Watershed Analysis Unit" during road construction, re-construction, and timber harvest planning.
- c. The training course shall include instruction regarding implementation of the "High Hazard Mass Wasting Prescriptions".
- d. The training course shall include a review of the guidelines and information contained in California Geological Survey (CGS) Notes 45 and 50.
- e. The training course shall be a required pre-requisite for RPFs preparing and submitting THPs using the Mattole Watershed Analysis (WA) prescriptions. Record of RPF course participation shall be maintained by HRC and made available upon request by the HCP signatory agencies.

2. Screening

Site-specific office and field “screening” for the identification of landscape geomorphology indicative of potentially unstable slopes within or adjacent to areas being considered for road construction, re-construction, or timber harvest shall be conducted.

- a. The RPF shall use the methodology provided in the “Hillslope Management Checklist for the Mattole Watershed Analysis Unit” during road construction, re-construction, or timber harvest planning for the purposes of:
 - Identifying active or potential high hazard mass wasting areas, to which the appropriate high hazard mass wasting prescriptions shall be applied;
 - Determining if licensed geologic review is required, and if so, where.
- b. Where licensed geologic review is required as a result of implementation of the “Hillslope Management Checklist for the Mattole Watershed Analysis Unit”, it shall be conducted by a CLG in a manner consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45 Guidelines).
- c. Where potential high hazard mass wasting areas are not indicated by use of the “Hillslope Management Checklist for the Mattole Watershed Analysis Unit”, the RPF shall determine the appropriate prescription to be applied consistent with the HRC Habitat Conservation Plan (HCP) and the California Forest Practice Rules (FPRs).

3. High Hazard Mass Wasting Prescriptions

Prescriptions for inner gorge, headwall swale, and other potential unstable geomorphic slope conditions are presented below and summarized in Table 1. If any area within the RMZ is subject to mass-wasting prescriptions, then the more restrictive of the RMZ and mass-wasting prescriptions applies for that area.

a. Mass-Wasting High Hazard Prescriptions:

1. Inner Gorge (see definition at end of section):

a. Inner Gorges on Class I Watercourses (All Sub-basins) –

1. **Harvest** – No timber harvest is permitted on inner gorge slopes draining to a Class I watercourse. Delineation of boundaries necessary for implementation of this prescription shall be flagged on the ground prior to THP pre-harvest inspection.
2. **Roads** – New road construction/re-construction across Class I inner gorge slopes is strongly discouraged and is prohibited without a CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45).

Circumstances where limited construction can occur with a CLG evaluation include the development of access to permitted stream crossings and watershed restoration project sites provided HRC notifies the HCP Wildlife Agencies of the proposed activity in writing prior to THP/project submittal. This advance written notification shall include explanation and justification regarding the necessity of the new road construction or re-construction. Review of the proposal by the Wildlife Agencies shall be conducted in accordance with the standard THP CEQA-equivalent review process, or other review process in the instance of a non-THP project.

b. Inner Gorges on Class II Watercourses (All sub-basins) -

1. **Harvest** - No timber harvest is permitted on inner gorge slopes within 200 feet (slope distance) of a Class II watercourse.

If inner gorge slopes extend further than 200 feet upslope of a Class II watercourse, harvest may occur on that portion of the inner gorge located further than 200 feet (slope distance) from the Class II watercourse provided the following conditions are met:

1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
2. A CLG shall determine timber harvest can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources
3. A CLG shall work with the RPF to develop an appropriate enforceable harvest prescription taking into account the potential effects of both silviculture and yarding method on slope stability
4. The harvest prescription shall include a minimum post harvest retention of 50 percent tree canopy cover well-distributed over the inner gorge slopes

Delineation of boundaries necessary for implementation of this prescription shall be flagged on the ground prior to THP pre-harvest inspection.

2. **Roads** - New road construction/re-construction across Class II inner gorge slopes is strongly discouraged and is prohibited without CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45).

Circumstances where limited construction can occur include the development of access to permitted stream crossings, short segments of less than 150 feet necessary to connect road alignments otherwise located outside of the inner gorge, and watershed restoration sites. HRC shall notify the HCP Wildlife Agencies of any such proposal prior to THP/project submittal. This written notification shall include explanation and

justification regarding the necessity of the new road construction or re-construction and is intended to provide the Wildlife Agencies with opportunity to provide comment or specific recommendation on the proposal as part of the THP or other project permitting review process.

2. Headwall Swales (see definition)

1. **Harvest** - No timber harvest is permitted on or within 25 feet of a Headwall Swale unless the following conditions are met:
 1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
 2. A CLG shall determine timber harvest can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources
 3. A CLG shall work with the RPF to develop an appropriate enforceable harvest prescription taking into account the potential effects of both silviculture and yarding method on slope stability
 4. The harvest prescription shall include a minimum post harvest retention of 50 percent tree canopy cover well-distributed over the headwall swale feature

Delineation of boundaries necessary for implementation of this prescription shall be flagged on the ground prior to THP pre-harvest inspection.

2. **Roads** - New road construction/re-construction across headwall slopes is strongly discouraged and is prohibited without CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45).

3. Translation/Rotational (see definition)

1. **Harvest** – No timber harvest is permitted on dormant historic to active translational and/or rotational landslides unless the following conditions are met:
 1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
 2. A CLG shall determine timber harvest can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources

3. A CLG shall work with the RPF to develop an appropriate enforceable harvest prescription taking into account the potential effects of both silviculture and yarding method on slope stability. Ground disturbance shall be planned to avoid interruption of natural drainage patterns, concentration of flows on slide mass, and deep cut slopes into slide deposits.
4. The harvest prescription shall include a minimum post harvest retention of 25 percent tree canopy cover well-distributed over the feature

Delineation of boundaries necessary for implementation of this prescription shall be flagged on the ground prior to THP pre-harvest inspection.

2. **Roads** - New road construction/re-construction is prohibited without CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45). To the extent feasible and appropriate, new road construction shall utilize existing benches, avoid removal of toe material, be constructed to a single lane in width, and out-sloped to avoid cutting into and concentrating water on the slide mass.

4. Earth Flow (see definition)

1. **Harvest** – No timber harvest is permitted on dormant historic to active earthflows unless the following conditions are met:
 1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
 2. A CLG shall determine timber harvest can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources
 3. A CLG shall work with the RPF to develop an appropriate enforceable harvest prescription taking into account the potential effects of both silviculture and yarding method on slope stability. Ground disturbance shall be planned to avoid interruption of natural drainage patterns, concentration of flows on slide mass, and deep cut slopes into slide deposits.

Delineation of boundaries necessary for implementation of this prescription shall be flagged on the ground prior to THP pre-harvest inspection.

2. **Roads** - New road construction/re-construction is prohibited without CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45). To the extent feasible and appropriate, new road construction shall utilize existing benches, avoid removal of toe

material, be constructed to a single lane in width, and out-sloped to avoid cutting into and concentrating water on the slide mass.

5. Other High Hazard Unstable Areas

1. **Harvest** - No timber harvest is permitted on any other identified unstable area (not specifically prescribed for above) unless an on-site geologic assessment conducted by a CLG working with the RPF results in a site-specific prescription that allows for harvest that is not likely to increase risk to aquatic resources. The geologic assessment shall be consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45).
2. **Roads** - New road construction/re-construction is prohibited without CLG evaluation consistent with the standards and practice of geology in the State of California (e.g., CGS Note 45). To the extent feasible and appropriate, new road construction shall utilize existing benches, avoid removal of toe material, be constructed to a single lane in width, and out-sloped to avoid cutting into and concentrating water on the slide mass.

6. Steep Streamside (>65%) Slopes Provisions (Large Class II Watercourses Only)

1. **Harvest** – No timber harvest is permitted on slopes >65% draining directly to a Class II watercourse, without a break-in-slope, to a maximum distance of 200 feet unless the following conditions are met:
 1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
 2. A CLG shall determine timber harvest can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources
 3. A CLG shall work with the RPF to develop an appropriate enforceable harvest prescription taking into account the potential effects of both silviculture and yarding method on slope stability
 4. The harvest prescription shall include a minimum post harvest retention of well-distributed 40 percent tree canopy cover
(Rattlesnake and Oil Creek sub-basins only)

A break-in-slope is defined as a change in slope angle to $\leq 65\%$ for a distance of greater than 100 feet.

2. **Roads** - New road construction is prohibited within 200 feet of a Class II watercourse on slopes >65% draining directly to the watercourse (i.e. no break-in-slope), unless the following conditions are met:

1. A CLG shall conduct a geologic assessment consistent with the standards and practices of geology in the State of California (e.g. CGS Note 45)
2. A CLG shall determine road construction can occur in a manner not likely to increase risk of landslide related sediment delivery to aquatic resources

Table 1. Summary of Potential High Hazard Area Prescriptions (Additional enforceable prescriptions contained in narrative text)

Geomorphic Condition	Harvest Prescription Summary	Road Construction Summary
Class I Inner Gorge	No Harvest	Licensed Geologic Review; Wildlife Agency Notification
Class II Inner Gorge	No Harvest w/in 200'; Licensed Geologic Review beyond 200' and retain minimum 50% tree canopy	Licensed Geologic Review; Wildlife Agency Notification
Headwall Swale	Licensed Geologic Review; Retain minimum 50% tree canopy well-distributed across feature and adjacent 25' buffer	Licensed Geologic Review
Translational/Rotational	Licensed Geologic Review; Retain minimum 25% tree canopy well-distributed across feature	Licensed Geologic Review
Earthflow	Licensed Geologic Review	Licensed Geologic Review
Other Unstable Area	Licensed Geologic Review	Licensed Geologic Review
Large Class II Steep Streamside Slope: Slopes >65% draining directly to Class II watercourse without BIS; Applicable to maximum distance of 200 feet from watercourse	Licensed Geologic Review (<i>All sub-basins</i>) Retain minimum 40% tree canopy cover well-distributed throughout zone (<i>Oil and Rattlesnake Creek sub-basins only</i>) Steep Streamside management zone terminates at break-in-slope or 200 feet (whichever comes first)	Licensed Geologic Review

The Hillslope Management Checklist for the Mattole Watershed Analysis Unit

*Modified from the CALIFORNIA LICENSED FORESTERS ASSOCIATION
GUIDE TO DETERMINING THE NEED FOR INPUT FROM A
LICENSED GEOLOGIST DURING THP PREPARATION*

In order to identify areas of very high risk of mass-wasting, the following questions should be addressed by the RPF during THP preparation.

1. *Are there unstable areas located within or adjacent to the proposed THP area?*
 - A. *Were active features indicated on the maps available for the watershed? The RPF will review Mattole Watershed Analysis (WA) maps and appropriate CGS maps, aerial photos, and previous THPs in the area to identify areas of concern.*
 - B. *Were unstable areas observed in the field?*
 - i. *Is an inner gorge (as defined in Mattole WA prescriptions), present? If the answer is yes, the appropriate Inner Gorge Prescription is to be applied. If the answer is no, proceed with the evaluation.*
 - ii. *Is a headwall swale (as defined in Mattole WA prescriptions) present? If the answer is yes, the appropriate Headwall Swale Prescription is to be applied. If the answer is no, proceed with the evaluation.*
 - iii. *If the area being reviewed is not underlain by previously mapped deep-seated mass-wasting features, then the RPF should look for indicators of unstable areas that may include:*
 - *Hillslopes greater than 60 percent*
 - *Loose, unconsolidated soils*
 - *U-shaped swales*
 - *Irregular topography*
 - *Scarps*
 - *Benches*
 - *Hummocky ground*
 - *Surface cracks*
 - *Vegetative indicators*
 - *Leaning trees*
 - *Hydrophytes*
 - *Isolated patches of homogeneous vegetation*
 - *Disorganized drainage*
 - *Sag ponds*
 - *Seeps*
 - *Diverted watercourse*
 - *Road cut-bank failure*
 - *Road or landing fill failure*
 - iv. *If the area being reviewed is underlain by previously mapped deep-seated mass-wasting features, then the RPF should look for indicators of unstable areas that may include:*

If any of the features listed above is observed, consider part C and answer question 2.

- Hillslopes greater than 60 percent
- Ground cracks
- Sharp, fresh, or unvegetated scarps or grabens
- Debris slides or debris flows on the surface of the deep-seated feature
- Recent rock fall or rock slides on the surface of the deep-seated feature
- Fresh/recent ground, road, or landing displacement
- Ponded or disrupted drainage (e.g., displaced stream channels, sag ponds, hydrophytes)
- Displaced/stressed/missing forest cover, frequent leaning and/or recurved (bent) trees
- Steep toes of deep-seated landslides or earthflows along stream edges or stream escarpments

If any of the features listed above is observed, consider part C and answer question 2.

- C. *If unstable areas were identified in the THP area as listed in iii & iv above, proposed timber operations on, adjacent to, upslope, or downslope of these features may have the potential to affect slope stability through:*
- *Displacement of soil*
 - *Division or concentration of drainage*
 - *Reduction in interception or transpiration, and/or*
 - *Reduction in root strength*
- Examples of timber operations that may produce these effects are:*
- *Timber cutting*
 - *Construction, reconstruction, and maintenance of:*
 - *Roads*
 - *Stream watercourse crossings*
 - *Skid trails*
 - *Beds for felling of trees (layouts)*
 - *Fire breaks*
1. *Mechanical site preparation*
 2. *Prescribed burning*
2. *Do the proposed timber operations have a reasonable potential to affect slope stability, and a potential for materials from landslides or unstable areas to affect public safety, water quality, fish habitat or other environmental resources? If the answer is yes, the area will receive the appropriate High Hazard Prescription. If the answer is no, the RPF determines the appropriate prescription to be applied to the area consistent with the California Forest Practice Rules.*

Definitions:

Averaging Slope - A technique for averaging slopes using a 100 foot by 100 foot square block (e.g., 100 feet along streams by 100 feet upslope).

Break-in-slope - For the purposes of these prescriptions, a break-in-slope is defined as a reduction in slope for at least 100 feet.

Earthflow – An earthflow is a landslide resulting from slow to rapid flowage of saturated soil and debris in a semi-viscous, highly plastic state. After initial failure, the earthflow may move, or creep, seasonally in response to destabilizing forces. Slide materials erode easily, resulting in gullying and irregular drainage patterns (CGS Note 50).

Headwall Swale - A concave slope, with steep convergent slopes (typically >65%) connected to Class I, II, or III waters via a continuous linear depression. (A linear depression interrupted by an active to dormant young landslide deposit is considered continuous for this definition. Concave, convergent slopes are teardrop-shaped depressions in the hillside that lead directly to a Class I, II or III watercourse.)

Inner Gorge - A geomorphic feature formed by coalescing scars originating from landsliding and erosional processes caused by active stream erosion. The feature is identified as that area of stream bank situated immediately adjacent to the stream channel, having a side slope of generally over 65 percent, and situated below the first break in slope above the stream channel. (CGS Note 50)

Other High Hazard Mass Wasting Area – Any discrete slide area or unstable soils (not more specifically defined, i.e. earthflow, headwall swale, inner gorge, translational/rotational) which have the potential to affect public safety, water quality, fish habitat or other environmental resources, as determined by use of the Mattole WAU Hillslope Management Checklist.

Translational/Rotational – A geomorphic feature characterized by a somewhat cohesive slide mass and a failure plane that is relatively deep when compared to that of a debris slide of similar areal extent.

6.3.4.1.2 Class I Riparian Management Zone (RMZ)

All fish bearing (or restorable) Class I waters in the Mattole Watershed Analysis Unit shall have a Riparian Management Zone (RMZ). The RMZ shall be divided into two bands, an inner band and an outer band. Inner and outer band riparian management zone widths are provided in Table 2. Class I RMZ prescriptions may be modified as a result of watershed analysis re-visitation.

1. Prescriptions for the Entire Class I RMZ:

1. The RMZ width shall be measured as slope distance from the watercourse transition line or, if present, the outer channel migration zone (CMZ) edge on each side of the watercourse.
2. No sanitation salvage, exemption harvest, or emergency timber operations (as defined and allowed in the FPRs) shall occur in the RMZ, except as per prior agreement with the wildlife agencies.
3. All portions of downed wood (i.e., LWD), except as defined as slash in the FPRs, will be retained. Slash will be retained at those sites where it will contribute to soil stabilization and sediment filtration. Exceptions may be proposed in a THP and approved by the wildlife agencies.
4. Trees felled during current harvesting operations, and THP-approved road construction, are not considered downed wood for purposes of retention.
5. Felled hazard trees or snags not associated with a THP are considered downed wood and are to be retained in the general vicinity.
6. Trees that fall naturally onto roads, landings, or harvest units within the RMZ are considered downed wood and are to be retained in the general vicinity.
7. All non-hazard snags will be retained, as per the snag policy in the HCP.
8. The RMZ is an equipment exclusion zone (EEZ) for timber operations, except for roads and permitted equipment crossings. Ground-based equipment crossings through the RMZ that do not cross the watercourse are permitted provided the purpose is to access harvest areas outside of the RMZ which could otherwise not be accessed without more significant ground disturbance. Ground-based skid trails shall not be designated for use in the RMZ for the sole purpose of conducting ground-based yarding operations within the RMZ. An explanation and justification for use of a skid trail in the RMZ, other than at a permitted equipment watercourse crossing, shall be included in the THP; and exposed mineral soils resulting from use shall be treated per HCP section 6.3.3.8.
9. Full suspension yarding will be used when and where feasible. Full suspension yarding may not be feasible on flat ground, in other sites with limited deflection, where an adjacent landowner will not provide permission to secure a cable, total yarding spans of greater than 1500 feet, or where a full suspension yarding system would jeopardize the safety of field personnel. For these conditions, yarding will be conducted in a manner that avoids ground disturbance that might deliver sediment to waters to the maximum extent practicable. Where ground disturbance occurs, HRC will treat the site as per HCP 6.3.3.8.

10. Trees not marked for harvest may be felled within the RMZ to provide safety clearance for cable yarding corridors. Such felling will be done only as needed to ensure worker safety. In such cases, to the extent possible given site conditions and the FPRs, trees will be felled toward the waters to provide LWD and will be identified in THPs as an in lieu practice (14 CCR 916.1). Regardless, trees felled within the RMZ for safety purposes will be retained as downed wood unless post harvest canopy retention requirements can be met following removal and harvest is approved by the responsible RPF. Trees located within designated no harvest areas shall not be harvested.
11. Trees not marked for harvest which are damaged in the cable yarding corridors must be retained in place, either standing or as downed wood unless post harvest canopy retention requirements can be met following removal and harvest is approved by the responsible RPF. Trees located within designated no harvest areas shall not be harvested.
12. There will be a maximum of one entry every 20 years, unless by written consent of the agencies for the sole purpose of speeding up of LWD recruitment potential
13. If any area within the RMZ is subject to mass-wasting prescriptions, then the more restrictive of the RMZ and mass-wasting prescriptions applies for that area.
14. Site preparation will be conducted according to HCP Section 6.3.4.2.
15. When necessary and applicable, the boundary of the inner and outer RMZ bands shall be clearly identified on the ground with paint, flagging, or other suitable means prior to the PHI.
16. Exclusive of the 18 largest trees per acre on each side of the Class I watercourse, selection of additional trees to meet required canopy retention shall include those with the highest probability of recruitment to the watercourse.

2. Prescriptions Unique to Class I Inner Band: 0 – 50 feet

1. Pursuant to HCP Section 6.3.2.2, 0 to 30 feet is no harvest; while the remainder of the inner band is no harvest unless otherwise approved by the wildlife agencies. This restriction includes sanitation salvage, exemption harvest, or emergency timber operations. For the purpose of adding LWD recruitment, felling trees from within the inner band will be allowed when approved by the wildlife agencies. Trees felled for these purposes are considered downed wood.
2. Road segments within the first 30 feet of the inner band must be mitigated by extending the inner band on the opposite side of the waters from the existing road an equivalent distance of that portion of the road prism within the inner band. In the case of RMZ road crossings, the first 50 feet of road extending inland from the watercourse transition line is exempt from this mitigation.

3. Prescriptions Unique to Areas within 0 to 100 feet of Class I Watercourses

1. *The 18 largest conifer trees per acre (measured as 435 feet of watercourse length and within 100 feet of the watercourse and lake transition line) shall be retained on each side of the watercourse per each harvest entry as per HCP Section 6.3.2.2 Item 7.*

4. Prescriptions Unique to the Class I Outer Band: Slope Dependent – See Table 2.

1. No harvest is permitted within the outer band on slopes $>65\%$ leading directly to a Class I watercourse. This prescription terminates at upper extent of the outer band (see Table 2) or at the break-in-slope (defined as a break-in-slope $\leq 65\%$ for a distance of greater than 100 feet).
2. Where harvest is permitted and prescribed for in the Outer Band the following requirements shall be in effect:
 - a. A base mark below the cut line of residual or harvest trees shall be placed in advance of the PHI by the RPF or supervised designee.
 - b. Silviculture method shall consist of selection harvest only.
 - c. A minimum of 65 percent total canopy closure shall be retained post-harvest, leaving a well-distributed, multi-storied stand composed of a diversity of species and structure similar to that found before the start of operations.
 - d. A minimum of 50 percent conifer overstory canopy closure shall be retained post-harvest. If less than 50 percent conifer overstory closure exists pre-harvest, then no conifer harvest shall occur.
 - e. Trees retained to meet outer band canopy retention requirements shall include those with indicators of high probability of recruitment to watercourses (e.g. leaning towards watercourse).

Table 2: Class I Watercourse Riparian Management Zone (RMZ) Buffer Widths and Harvest Prescription Summary – Additional enforceable RMZ prescription measures contained in narrative text

Slope/Sub-basin	Inner Band Width	Prescription Summary	Outer Band Width	Prescription Summary
>65%				
All Sub-basins	0-50 feet	No Harvest	50 – 150 feet maximum or Break-in-Slope	No Harvest ; if slope breaks prior to 150 feet then ≤ 65% SEB prescription applies for remaining zone width to 150 feet terminus
≤65%				
All Sub-basins	0-50 feet	No Harvest	50-150 feet	<p>Selective Entry Band (SEB)</p> <p>Retain minimum of 65% total canopy cover (conifer + hardwood) well-distributed throughout outer band post-harvest</p> <p>Retain minimum of 50% overstory conifer canopy cover post-harvest</p> <p>Selection harvest must result in increased average stand diameter post-harvest</p>
Inner Gorge Slopes	See Hillslope Mgmt (6.3.3.7)			

6.3.4.1.3 Class II RMZs

All Class II waters will have a RMZ. The RMZ shall be divided into two bands, an inner band and an outer band. The width of these bands is dependent upon the size and drainage area of the watercourse. Large class II watercourses (>80 acre drainage area) shall be provided a 100 foot wide RMZ. Small Class II watercourses (≤ 80 acre drainage area) and isolated seeps, springs, and wetlands shall be provided a 75 foot wide RMZ.

Management of Class II waters situated within the prism of a road or landing shall adhere to the prescriptions set forth in the January 2004 Adaptive Management modifications to HCP sections 6.3.4.1.3 f (bullet #3).

Class II RMZ prescriptions may be modified as a result of watershed analysis re-visitiation.

1. Prescriptions for the Entire Class II RMZ

1. The RMZ width shall be measured in slope distance from the watercourse transition line (HCP definition) or if present, the CMZ edge on each side of the watercourse.
2. No sanitation salvage, exemption harvest, or emergency timber operations (as defined and allowed in the FPRs) shall occur in the RMZ, except as per prior agreement with the wildlife agencies.
3. All portions of downed wood (e.g., LWD), except as defined as slash in the FPRs, will be retained. Slash will be retained at those sites where it will contribute to soil stabilization and sediment filtration. Exceptions may be proposed in a THP and approved by the wildlife agencies.
4. Trees felled during current harvesting operations and THP-approved road construction are not considered downed wood for purposes of retention.
5. Felled hazard trees or snags not associated with a THP are considered downed wood and are to be retained near the location of the removal.
6. Trees that fall naturally onto roads, landings, or harvest units within the RMZ are considered downed wood and are to be retained near the location of the removal.
7. All non-hazard snags will be retained, as per the snag policy in the HCP.
8. The RMZ is an equipment exclusion zone (EEZ) for timber operations, except for roads and permitted equipment crossings. Ground-based equipment crossings through the RMZ that do not cross the watercourse are permitted provided the purpose is to access harvest areas outside of the RMZ which could otherwise not be accessed without more significant ground disturbance. Ground-based skid trails shall not be designated for use in the RMZ for the sole purpose of conducting ground-based yarding operations within the RMZ. An explanation and justification for use of a skid trail in the RMZ, other than at a permitted equipment watercourse crossing, shall be included in the THP; and exposed mineral soils resulting from use shall be treated per HCP section 6.3.3.8.
9. Full suspension yarding will be used when feasible. Full suspension yarding is not feasible on flat ground, in other sites with limited deflection, where an adjacent landowner will not provide permission to secure a cable, or where a full suspension yarding system would jeopardize the safety of field personnel. For the purposes of this prescription, the expanded definition of feasibility according to the FPRs does not apply as an additional determination beyond that described above. For these conditions, yarding will be conducted in a manner that avoids ground disturbance that might deliver sediment to waters to the maximum extent practicable. Where ground disturbance occurs, HRC will treat the site as per HCP Section 6.3.3.8 (revised August 11, 2004).

10. Trees not marked for harvest may be felled within the RMZ to provide safety clearance for cable yarding corridors. Such felling will be done only as needed to ensure worker safety. In such cases, to the extent possible given site conditions and the FPRs, trees will be felled toward the waters to provide LWD and will be identified in THPs as an in-lieu practice (14 CCR 916.1). Regardless, trees felled within the RMZ for safety purposes will be retained as downed wood unless harvest is approved by the responsible RPF and post harvest canopy retention requirements can be met following removal. Trees located within designated no harvest areas shall not be harvested.
11. Trees not marked for harvest which are damaged in the cable yarding corridors must be retained in place, either standing or as downed wood unless harvest is approved by the responsible RPF and post harvest canopy retention requirements can be met following removal. Trees located within designated no harvest areas shall not be harvested.
12. There will be a maximum of one entry every 20 years.
13. If any area within the RMZ is subject to mass-wasting prescriptions, then the more restrictive of the RMZ and mass-wasting prescriptions applies for that area.
14. Site preparation will be conducted according to HCP Section 6.3.4.2.

2. Prescriptions Unique to Class II Inner Band: 0 to 30 feet (All sub-basins)

1. Unless otherwise approved by the wildlife agencies, timber harvest will not occur within the inner band. This restriction includes sanitation salvage, exemption harvest, or emergency timber operations. For the purpose of adding LWD to the stream, or for the release of riparian stands for LWD to enhance development of trees capable of providing key-piece-sized LWD and future LWD recruitment, felling trees from within the 10 to 30 foot portion of the inner band will be allowed when approved by the wildlife agencies on a THP-by-THP basis in accordance with HCP Section 6.3.2.2 Item 7. Trees felled for these purposes are considered downed wood.
2. Road segments within the no-harvest band must be mitigated by extending the no-harvest band on the opposite side of the waters from the existing road an equivalent distance of that portion of the road prism within the no-harvest band. In the case of RMZ road crossings, the first 300 feet of road extending inland from the watercourse transition line is exempt from this mitigation.

3. Prescriptions Unique to Class II Outer Band

1. Riparian Management Zone outer band widths shall be established in the field per Table 3.
2. The RMZ shall be clearly identified on the ground by the RPF who prepared the THP, or a supervised designee, with paint, flagging, or other suitable means prior to the PHI.
3. Silviculture method shall consist of single-tree selection harvest only.

4. A minimum of 65 percent total canopy closure shall be retained post-harvest, leaving a well-distributed, multi-storied stand composed of a diversity of species and structure similar to that found before the start of operations.
5. A minimum of 50 percent conifer overstory canopy closure shall be retained post-harvest. If less than 50 percent conifer overstory closure exists pre-harvest, then no conifer harvest shall occur.
6. A base mark below the cut line of residual or harvest trees within the outer band shall be placed in advance of the PHI by the RPF or supervised designee.
7. Trees left to meet outer band canopy requirements shall include those with the highest probability for recruitment to watercourses.

Table 3: Class II Watercourse Riparian Management Zone (RMZ) Buffer Widths and Harvest Prescription Summary – Additional enforceable RMZ prescription measures contained in narrative text

Slope/Sub-basin	Inner Band Width	Prescription Summary	Outer Band Width	Prescription Summary
>65% Slope (Large Class II)				
Rattlesnake, Oil Creek	0-30 feet	No Harvest	30-100 feet	No Harvest ; if slope breaks prior to 100 feet then ≤ 65% SEB prescription applies for remaining zone width to 100 feet terminus
LNF Mattole sub-basins; McGinnis, Pritchard, Conklin	0-30 feet	No Harvest	30-100 feet	30-50 feet – No Harvest ; if slope breaks prior to 50 feet then ≤ 65% SEB prescription applies for remaining zone width to 100 feet terminus 50-100 feet – Selective Entry Band (See Below)
≤ 65% Slope (Large Class II)	Inner Band Width	Prescription Summary	Outer Band Width	Prescription Summary
All sub-basins	0-30 feet	No Harvest	30-100 feet	Selective Entry Band (SEB) Retain minimum of 65% total canopy cover (conifer + hardwood) well-distributed, multi-storied stand composed of a diversity of species and structure similar to that found before the start of operations Retain minimum of 50% conifer canopy cover post-harvest
Standard/Small Class II (≤ 80 acre drainage); and isolated Class II waters including Seeps, Springs, and Wetlands				
All Slopes	Inner Band Width	Prescription Summary	Outer Band Width	Prescription Summary
All sub-basins	0-30 feet	No Harvest	30-75 feet (or 30-100 feet ¹)	Selective Entry Band (SEB) Retain minimum of 65% total canopy cover (conifer + hardwood) well-distributed, multi-storied stand composed of a diversity of species and structure similar to that found before the start of operations Retain minimum of 50% conifer canopy cover post-harvest
Inner Gorge Slopes	<i>See Hillslope Mgmt (6.3.3.7)</i>			

¹ The standard/small RMZ width shall be extended 25 feet to a total distance of 100 feet in instances where the silviculture adjacent the RMZ will reduce forest canopy to less than 40 percent cover over an area greater than ¼ acre

6.3.4.1.4 Class III RMZs

All Class III watercourses will have a RMZ. The RMZ shall be 50 feet in width (slope distance) as measured from the watercourse transition line.

Class III RMZ prescriptions may be modified as a result of watershed analysis re-visitation.

1. Prescriptions for All Class III RMZs

1. If any area within the RMZ is subject to mass-wasting prescriptions, then the more restrictive of the RMZ and mass-wasting prescriptions applies for that area.
2. All RMZ requirements stop at the hydrologic divide.
3. The RMZ is an equipment exclusion zone (EEZ) for timber operations, except for roads and permitted equipment crossings. Ground-based equipment crossings through the RMZ that do not cross the watercourse are permitted provided the purpose is to access harvest areas outside of the RMZ which could otherwise not be accessed without more significant ground disturbance. Ground-based skid trails shall not be designated for the sole purpose of conducting ground-based yarding operations within the RMZ. An explanation and justification for use of a skid trail in the RMZ, other than at a permitted equipment watercourse crossing, shall be included in the THP; and exposed mineral soils resulting from use shall be treated per HCP section 6.3.3.8.
4. Retain all trees that have any of the following characteristics: a) situated within the bank-full channel; b) boles-in-contact with the bank-full channel; and c) have large roots providing bank stability. Bole-in-contact with the bank-full channel means that the vertical line of the bole overlaps with the bank-full channel.
5. A minimum of 50 percent total canopy closure shall be retained in a well-distributed manner throughout the RMZ post-harvest.
6. Some Class III channels are located at the base of small, steep, erosional features immediately adjacent to the channel. These features may or may not be vegetated. In these situations, retain all trees within 10 feet (slope distance) from the bank-full edge of the channel that are in the portion of the topographic cross section extending from the bank-full width up to the first break-in-slope (including those trees whose bole is in contact with the break-in-slope). Bole-in-contact with the break-in-slope means that the vertical line of the bole overlaps with the break-in-slope. Break-in-slope for the Class III prescription is defined as any change in the slope (no minimum distance is required).
7. All downed wood and debris shall be retained within the EEZs, except for cases of emergency as per agreement with the wildlife agencies.
8. All downed wood and debris in the channel shall be retained.
9. Trees felled during current harvesting operations and THP-approved road construction is not considered downed wood for purposes of retention.
10. Felled hazard trees or snags not associated with a THP are considered downed wood and are to be retained in the nearest safe location.

11. Trees that fall naturally onto roads, landings, or harvest units within the EEZs shall be treated as downed wood and are to be retained in the nearest safe location.
12. To the extent feasible, directionally fell harvest trees away from Class III watercourses.
13. To the extent feasible retain all ground cover and sub-merchantable vegetation within RMZs.
14. Site preparation will be conducted according to HCP Section 6.3.4.2.

Table 4: Class III Watercourse Riparian Management Zone (RMZ) Buffer Widths and Harvest Prescription Summary – Additional enforceable RMZ prescription measures contained in narrative text

Watercourse Type	Total RMZ Width	RMZ Harvest Prescriptions
Class III	0-50 feet or hydrologic divide	<ul style="list-style-type: none"> - A minimum of 50 percent total canopy closure shall be retained in a well-distributed manner throughout the RMZ post-harvest -Retain all trees that have any of the following characteristics: a) situated within the bank-full channel; b) boles-in-contact with the bank-full channel; c) have large roots providing bank stability; and d) located on or within steep erosional features immediately adjacent the channel -Retain all downed wood within RMZ -All Class III RMZ prescriptions end at the hydrologic divide

6.3.4.3 Disturbance Index¹

1. The disturbance index and its elements may be modified subject to approval by the wildlife agencies.
2. The disturbance index will be calculated at the sub-basin scale.
3. The disturbance index shall be calculated on an annual basis and updated by March 1 of each year for the activities conducted in the previous calendar year. With submittal of each THP in the Mattole Watershed Analysis Unit, HRC shall calculate and present the most recent disturbance index in the relevant sub-basin.
4. In sub-basins where the disturbance index is equal to or greater than 150 percent above the estimate of background level, HRC shall conduct sediment mitigation activities sufficient to result in a net decrease of the index value for the year.
5. In sub-basins where the disturbance index is less than 150 percent above background levels, HRC may conduct covered activities in the subject THP with the limitation that such operations will not result in a net increase in the disturbance index above 150 percent over background threshold for the year.
6. In all sub-basins where timber operations are conducted, HRC shall ensure, in addition to other road related measures in the HCP, that the surface of hydrologically connected road segments shall be treated (e.g., with rock, chipseal or pavement) to avoid any visible increase in turbidity in waters receiving runoff from the road surface of appurtenant road segments. Roads shall be treated prior to October 15th the first year in which used for timber operations. Seasonal, native surfaced roads may be treated using seed and straw or slash mulch if not used for timber operations during the winter period.
7. Within each sub-basin, stormproofing, road decommissioning, and updated road surface erosion estimates shall also be calculated and included in the disturbance index on an annual basis.
8. Upon delivery of the annually revised disturbance index estimates to the wildlife agencies, a meeting shall be convened within 60 days between HRC and the wildlife agencies to review the disturbance index and to set priorities for the coming year. In particular, this meeting will be used to assign stormproofing efforts, if needed, and to address any unexpected increases in the disturbance index in sub-basins where such index values exceed 150 percent above background.

¹ Discussion regarding modification of the disturbance index in order to more accurately and transparently account for forest management effects on watershed values and aquatic habitat occurred during prescription development. While no changes were made to the methodology at the time of the Mattole WA prescriptions establishment, modifications may occur in the future, per bullet item #1 above.

6.3.5 Aquatic Monitoring

Below is an outline of stream temperature and watershed-wide level forensic landslide monitoring to be conducted in the Mattole Watershed Analysis Unit in addition to monitoring described in the HCP.

HRC and the wildlife agencies may agree to modify the specifics of this monitoring plan in the development of the detailed work plan.

Mattole Stream Temperature Monitoring

Oil Creek Class I Monitoring –

Objective: Obtain five years of baseline water temperature data in Oil Creek near the downstream property boundary. Install summertime HOBO temperature gages per WOP 09 protocol at suitable location at or near location designated on map.

Mattole Watershed - Level Forensic Landslide Monitoring

Objective: Document and assess mass wasting events within the Mattole watershed:

- 1) Achieve greater understanding of contributing factors to their occurrence, such as geology, slope, landform, distance from watercourse, association with management activities
- 2) To record location and timing of occurrence, size of mass wasting event, and if applicable, estimated volume of sediment delivered to watercourse.

Methods:

A watershed-wide reconnaissance level investigation for mass wasting events utilizing HRC's Watershed Operating Protocol 08 shall be conducted if either of the following "triggering events" occurs: (1) greater than 3 inches of rainfall within 24 hours as measured at Scotia; (2) a significant earthquake. Determining if an earthquake is a "triggering event" shall be based upon earthquake magnitude and distance of epicenter from the watershed referencing Figure 2., Graph A of Keefer (1984).

Record of triggering events including date and rainfall and the results of this investigation including collected data and summary tables shall be provided the wildlife agencies within 5 years of prescription establishment or as part of the Watershed Analysis re-visitation report.

Attachment 4

Mattole River Watershed Analysis

Glossary

From April 2000 Methods for Watershed Analysis
along with additional terms

TERMS IN ALPHABETICAL ORDER

active channel – A portion of the stream channel within the limits of the bankfull channel characterized by mobile sediment deposits or frequent submergence; the portion of the channel occupied by flow during winter baseflow conditions.

active riparian recruitment – Large woody debris (LWD) from riparian forest stands is entering the stream channel under current stand conditions; as distinct from LWD in stream channels that originated as debris from old-growth stands no longer present or as logging debris.

aerial (air) photo – A photograph of the earth's surface taken from the air. It is usually a vertical view, and one of a series of photos taken from an aircraft flying a systematic pattern at a given altitude in order to obtain continuous photo coverage for mapping purposes.

aerial photo interpretation – The identification of specific earth surface features and conditions by recognition of the patterns displayed on aerial photographs.

aggradation – An accumulation, often gradual, of sediment on a streambed that increases bed elevation and reduces channel capacity.

alluvial fan – A fan-shaped deposit of fluvial sand and gravel, usually located at the mouth of a tributary valley; a type of flood plain.

alluvial plain – A plain underlain by fluvial deposits, including alluvial (fluvial) fans and lacustrine deposits (stream-transported materials that have accumulated in lakes). See flood plain.

alluvium – Sediment deposits laid down by streams; usually refers to sand and gravel in channel deposits, but includes flood-plain deposits.

armor layer – Surface layer of material in a channel that is coarser than the underlying sediment.

bank erosion – The erosion of streambanks by a combination of processes, including undercutting of the bank during periods of peak streamflow and seepage erosion of sediment comprising the bank. This process may occur either rapidly or slowly.

bankfull channel – The portion of the channel that the stream normally occupies during regular high-water periods, which occur about every 0.5 to 2.0 years. There is often confusion regarding the distinction to be made between the “bankfull” criteria stated above and the literal “top of bank” criterion that often represents the channel dimension at a rare, extreme flood stage, or even a level of flow that is not likely to be reached under existing climatic conditions owing to past channel incision, tectonic uplift, or climate change.

bar – A sediment accumulation within the stream channel, which can specifically be located inside meander bends, on topographic high points within the channel, in the active channel parallel to the banks, or upstream of obstructions within the channel.

base level – A downstream elevation control on a stream channel. This may be either sea level, a lake, or a valley floor.

baseline – A quantitative level or value from which data and observations are referenced; data collected to establish the state of a system, process, or activity before the initiation of actions that may result in change.

basemap – The map (usually a topographic map) to which terrain mapping is added, either by drafting directly onto the basemap, or by drafting onto a transparent overlay.

bed load – Material transported in a stream that rolls, slides, and “hops” (saltates) downstream and is partly supported by the streambed; this in contrast with material carried in suspension or solution.

bedform – A gravel bar or sand dune in a stream channel.

bedrock – Solid rock, usually older than Quaternary (except rock formed by cooling of lava), either exposed at the land surface or underlying surficial deposits or regolith of varying thickness.

Glossary

bimodal – A characteristic of a histogram or frequency distribution where there are two peaks or modes.

braided channel – A stream reach characterized by multiple channel threads.

break-in-slope – Major change in the gradient of a topographic surface.

broadcast burning – a controlled burn, where the fire is intentionally ignited and allowed to proceed over a designated area within well-defined boundaries. It reduces fuel hazard after logging or is used for site preparation before planting. Also called slash burning.

buffer zone – a strip of land (often including undisturbed vegetation) where disturbance is not allowed or is closely monitored to preserve or enhance aesthetic and other qualities along or adjacent to roads, trails, watercourses, and recreation sites. In forest practices, riparian buffer zones are often retained to preserve riparian vegetation and habitat values and to act as a sediment trap to capture sediment from upland sources before it reaches a watercourse.

canopy – The overhanging cover formed by leaves, needles, and branches of vegetation.

canopy closure – Vegetation projecting over waters, including crown cover (generally more than 1 m above the water surface) and overhead cover (less than 1 m above the water surface).

canopy cover – The proportion of an area covered by tree crowns.

centroid – Mid-point between the landslide headscarp and base of landslide erosional void.

channel geometry – Physical channel characteristics that are typically used to determine channel flow capacity or hydraulic parameters; slope, width, depth, flow velocity.

channel migration zone (CMZ) – The boundary generally corresponds to the modern flood plain, but may also include river terraces that are subject to significant bank erosion; the area adjacent to watercourses constructed by the river in the present climate and inundated during periods of high flow. The CMZ corresponds to the 100-year floodplain adjacent to Rosgen channel types C, D, and E.

channel order – Refers to a system of channel classification in which a channel with no tributaries is called first-order; below the confluence with two first-order streams is a second-order stream, and so on.

channel response matrix – A table of data used to approximate sediment transport and response characteristics expected for channel segments defined through assessment using primarily map and aerial photo data.

channel roughness – Flow resistance; elements of the channel bed and shape that essentially slow the flow velocity.

channel segment – The basic stream mapping unit representing a part of the stream with unique characteristics.

channel sensitivity – Degree of potential physical channel change to a change in watershed inputs.

channel stability – Refers to the channel's ability to resist change in shape or position, whether attacked by flood or ice flows.

Class I, II, III streams – Stream classes as defined in the California Forest Practice Rules. Class I streams supply domestic water, or fish are always or seasonally present. Class II streams have fish present 1,000 ft downstream and/or provide aquatic habitat for nonfish species. Class III streams have no aquatic life present but have evidence of being capable of sediment transport to Class I or II waters.

clay – A rock or mineral fragment of any composition having a diameter less than 1/256 mm (4 micrometres) (Wentworth scale); a finely crystalline hydrous silicate of aluminum, iron, manganese, magnesium, and other metals belonging to the phyllosilicate group, such as kaolinite, montmorillonite, bentonite, and vermiculite—known as clay minerals.

clinometer – A device used to measure slope designed primarily for measurement of large angles; commonly used by foresters to determine tree height.

coarse sediment – Sediment particles greater than or equal to 2 mm in diameter.

Glossary

coarse-grained – Rock particles or sediment that are easily seen by the naked eye and have an average diameter greater than 2 mm (0.08 inches).

cobbles – A rock fragment between 64 and 256 mm intermediate diameter (Wentworth scale); rounded and subrounded rock fragments between 62 and 256 mm.

cohesion – Shear strength of a rock or particle not related to interparticle friction; the capacity of particles to stick or adhere together.

colluvial fan – A fan-shaped mass of sediments deposited by colluvial processes, most commonly debris flows.

colluvial processes – See slope processes and mass movement.

colluvium – Materials that have reached their present positions as a result of direct, gravity-induced mass movements. No agent of transportation such as water or ice is involved, although the moving material may have contained water or ice (in some definitions includes deposits resulting from slope wash). Includes talus, landslide debris, and debris-flow deposits. Usually distinguished from alluvium by the abundance of silt and clay.

compaction – A physical change in soil properties that results in an increase in soil bulk density and a decrease in porosity; the packing together of soil particles by forces exerted at the soil surface, resulting in increased soil density.

composite terrain polygon (unit) – A polygon (unit) that includes two or three types of basic elements, usually occurring repetitiously.

cone – A mountain, hill, or other landform shaped like a cone, having relatively steep slopes and a pointed top; a sector of a cone with a straight or concave long profile and slopes generally steeper than 15° (26%)—includes talus cones and avalanche cones .

confinement – The degree to which a stream channel is laterally constrained by hillslopes or terraces.

contacts (stratigraphic) – The surfaces that separate a stratigraphic unit from overlying and underlying units. May be sharp or gradational, horizontal or inclined, planar or wavy.

creep – The imperceptibly slow, more or less continuous downhill movement of soil or rock on slopes. The movement is essentially flow of a highly viscous medium under shear stresses sufficient to produce deformation but too small to produce shear failure as in a landslide.

critical shear stress – The threshold of value of shear stress that is sufficient to entrain a sediment particle or a representative grain size for a patch of streambed. See shear stress.

cross-drain culvert – A culvert used to carry ditch water from one side of the road to the other.

crown – The live branches and foliage of a tree.

crown closure – Synonymous with canopy closure.

crowned road – A road that is graded with the centerline of the road higher than the edges of the road. As a result, water drains from center of roadway toward both edges of road.

cutslope – The face of the excavated bank along the uphill side of a road.

dam-break flood – Similar to a debris torrent; a localized flood event generated by breaching of a debris dam formed by a landslide event.

debris flow – The downslope movement of unconsolidated, matrix-supported, water-laden materials that are capable of scour and deposition.

delta – An accumulation of stream-transported sediments deposited where a stream enters a body of water. The landform is flat or very gently sloping, triangular or fan-shaped in plan, and consists of fluvial (alluvial) gravel, sand, silt, and/or clay.

deposit – An accumulation of earth material resulting from naturally occurring physical, chemical, or organic processes.

Glossary

depression – A circular or irregular enclosed hollow separated from the surrounding area by a distinct slope break.

derivative (interpretive) maps – Maps derived from information contained on a terrain map or in a terrain database, but displaying information relevant only to some specific theme or application. Examples include slope-stability maps, urban capability maps, and maps of granular resources.

desynchronization – To affect the timing of two or more activities so as to make them less likely to occur simultaneously.

digital terrain data – Topographic data stored in computer files.

discharge – Rate of streamflow.

distortion (on aerial photos) – Distortion is caused by several effects, of which the two most relevant to aerial photo interpretation are as follows: Radial distortion occurs because the camera is not vertically above every point on the photograph—features near the edges appear to lean outward. Topographic distortion results from differences in scale related to topography—scale is larger where topography is high and camera-to-ground distance is least, and vice versa.

downcutting – The active incising by a stream of a streambed or valley due to erosion of sediment or bedrock.

drainage area – Upstream contributing watershed area to a point of interest.

drainage basin – See watershed.

dry ravel – Downslope movement of dry, noncohesive soil or rock particles under the influence of gravity; a form of soil creep.

duff – The layer of partially and fully decomposed organic materials lying below the litter and immediately above the mineral soil. It corresponds to the fermentation (F) and humus (H)

layers of the forest floor. When moss is present, the top of the duff is just below the green portion of the moss.

earth – Any or a mixture of soil, surficial materials, and weathered rock.

effective height for LWD – Effective height is the height of the tree where the stem diameter is equal to the minimum qualifying LWD diameter (i.e., 4 inches). This height is computed from a tree taper function.

entrainment – Initiation of movement of sediment on a streambed by streamflow.

entrenchment – The degree to which a stream channel is inset in the valley floor.

erosion – The removal of rock and soil from the land surface by a variety of processes: by gravitational stress, through mass wasting; or by the movement of a medium (e.g., water, in solution or by overland flow or channel flow).

erosional regime – A set of watershed conditions associated with a characteristic degree of erosion at the watershed scale.

escarpment – A steep slope that is usually of great lateral extent compared to its height, such as the risers of river terraces and steep faces associated with stratified rocks.

evapotranspiration – The combined processes by which water is transferred from the earth surface to the atmosphere; evaporation of liquid or solid water plus transpiration from plants. Evapotranspiration occurs through evaporation of water from the surface, evaporation from the capillary fringe of the groundwater table, and the transpiration of groundwater by plants (phreatophytes) whose roots tap the capillary fringe of the groundwater table. The sum of evaporation plus transpiration.

exceedance interval – The average number of years between the occurrence of an event (in this case, flood event) of a given magnitude and one that is more extreme.

Glossary

fan – An accumulation of detrital material in the shape of a low-angle cone, usually at the point where a stream emerges from a canyon onto a plain; a sector of a cone with gradient not steeper than 15°. See alluvial fan, colluvial fan.

felling – The process of cutting down standing timber and then cutting it into specific lengths for yarding and hauling.

field-check (verification) – Refers to the observations and written description of conditions at a particular site in a terrain polygon. Used to assess correctness of aerial photo interpretation and to collect information that cannot be obtained by aerial photo interpretation.

fillslope – The face of an embankment required to raise the desired road profile above the natural ground line (on downhill side of road tread).

fine sediment – Sediment particles less than 2 mm in diameter.

fine-grained – Rock particles or sediment that have an average diameter smaller than 2 mm (0.08 inches).

flight line – The succession of overlapping aerial photos (about 250) on one roll of film and identified by specific index numbers and letters; the succession of overlapping aerial photos taken along a single straight segment of the flight path of the aircraft.

flood hydrograph – A graphic depiction of the discharge of a stream over time.

flood plain – Level or very gently sloping surface bordering a river that has been formed by river erosion and deposition. It is usually subject to flooding and is underlain by fluvial sediments. Similar to alluvial plain.

flood-frequency curve – Graph showing the relationship between recurrence interval (or exceedence probability) and peak discharge (volume flux of water per unit time).

flood-plain width – Width of the area on both sides of a stream, which is subject to flooding.

flow regime – A set of hydrologic and watershed conditions that determine a watershed's characteristic hydrograph; e.g. snow-melt runoff regime versus storm runoff regime.

fluvial – Pertaining to streams and rivers. Similar to alluvial.

fluvial geomorphology – The branch of geomorphology devoted to the study of stream channels.

fluvial terraces – See river terraces.

fog drip – Occurs when fog droplets encounter an obstruction, coalesce, and fall to the ground. Fog drip occurs primarily near ridge crests during cool periods when temperatures are less than 50°F.

gentle slope – A planar surface sloping at 3 to 15°.

geological processes – Geomorphological processes; including those dynamic actions or events that take place below the earth's surface, and result in effects such as earthquakes and volcanism, as well as geomorphological processes.

geological structure – The three-dimensional arrangement of geological contacts and discontinuities, such as bedding, stratification, joints, faults, dykes, plutons, folds.

geomorphic regime – A set of geologic, hydrologic, and watershed conditions that determine a watershed's characteristic geomorphology; e.g., debris-flow-dominated landscapes.

geomorphic unit – An area encompassing portions of the channel network that are representative of similar fluvial processes.

geomorphological history – The evolution of landforms and landscapes, surface materials, and changes with time in geomorphological processes.

geomorphological processes – Dynamic actions or events that occur at the earth's surface due to application of natural forces resulting from gravity, temperature changes, freezing and thawing, chemical reactions, seismic shaking, and the agencies of wind and moving water,

Glossary

ice, and snow. Where and when a force exceeds the strength of the earth material, the material is changed by deformation, translocation, or chemical reactions.

geomorphology – The study of the origin of landforms, the processes whereby they are formed, and the materials of which they consist.

glacial till – Unsorted sediment transported by glaciers and deposited as they melt.

glomalin – a glycoprotein that is produced by a beneficial fungus that grows on plant roots and acts as a “glue” that builds and stabilizes aggregates in soils (USDA-ARS, 2006).

gradient – Channel slope or hillslope expressed as units of rise over units of run.

grading – An engineering term pertaining to the degree of sorting by size of particles in a clastic sediment or sedimentary rock. Sandy and gravelly materials with a wide range of particle sizes are termed “well graded”; material with a small range of sizes is “poorly graded.” (Note that these terms are the reverse of the geological expressions “well sorted” and “poorly sorted.”)

grain roughness – Flow resistance in a channel caused by sediment grains on the bed.

gravel – A loose accumulation of rock fragments greater than 2 mm in diameter; pertaining to stream gravel: a rounded rock particle with a median diameter between 2 mm and 64 mm.

gravel pavement – Similar to channel armor, but regarded as less likely to be entrained by flow, and more permanent.

ground-checking – Fieldwork carried out to assess the correctness of aerial photo interpretation or other sources of information. See also field-check.

gully – A small valley or ravine, longer than wide, and typically from a few meters to a few tens of meters across.

gully erosion – Advanced stage of surface erosion in which rills are formed in soil or soft rock by a variety of processes, including erosion by running water; erosion as a result of weathering

and the impact of falling rocks, debris slides, debris flows, and other types of mass movement; and erosion by snow avalanches.

HCP – Habitat Conservation Plan for the Properties of The Pacific Lumber Company, Scotia Pacific Company LLC, and Salmon Creek Corporation, February 1999.

headwall swale – Steep (generally greater than 50 percent), concave slopes at or near the heads of steep swales, gullies and Class II and Class III waters.

hillslope geomorphology – The study of hillslope processes (e.g., landslide and surface erosion processes), and how these processes affect the earth's surface.

historical condition – A description of the riparian condition (species composition, stand density, tree size, etc.) occurring within an area over time, beginning with pre-European settlement and extending up to the present.

hummocks – Steep-sided hillocks and hollows, nonlinear and chaotically arranged, and with rounded or irregular cross-profiles. Slopes are between 15 and 35° (26-70%) on surficial materials and between 15 and 90° (more than 26%) on bedrock.

hydraulic geometry – See channel geometry. Hydraulic geometry refers to a systematic analysis of the changes in the width, depth, and velocity of flow with changing streamflow or at different locations in a watershed under similar flow conditions.

hydraulic sorting – The process by which the variation in flow velocity at different locations acting on the bed creates patches of different-sized sediment particles on the streambed.

hydrograph – A graphic representation or plot of changes in streamflow or in the water level elevation plotted against time. A graph showing stage, flow, velocity, or other hydraulic properties of water with respect to time for a particular point on a stream.

Hydrologic Analysis Unit – Area within a watershed that has been delineated as having distinct hydrologic properties.

Glossary

hydrologic cycle – The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes such as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transportation.

hydrologic maturity – Condition of the forest stand in which hydrologic processes operate as they do in a mature or old-growth forest. In particular, snow accumulation is typically lower in thick, dense forest (at middle and lower elevations) than in openings, due to interstorm melting of snow caught in the canopy; snow-melt is slower, due to increased wind-aided flux of sensible and latent heat.

hydrology – The scientific study of the distribution and characteristics of water at and close to the earth's surface.

imbrication – See gravel pavement. A pattern of overlapping grain-to-grain contact that tends to make the bed resistant to mobilization by streamflow.

infiltration – The flow of a fluid into a solid substance through pores or small openings; specifically, the movement of water into soil or porous rock.

infiltration rate – Rate of downward movement or flow of water from the surface into the soil; the rate at which infiltration takes place, expressed in depth of water per unit time, usually in inches per hour.

inner gorge slope – Hillslopes greater than or equal to 65% and located below the last major break-in-slope leading to a watercourse.

input variables – For watershed analysis, regarded as sediment, wood, water, and thermal energy inputs to streams.

insloping – Shaping the road surface to direct water onto the cutslope (uphill) side of the road. Water is then carried in a ditch parallel to the road.

interception – The process of storing rain or snow on leaves and branches, with eventual evaporation back to the air. Interception equals the precipitation on the vegetation minus stemflow and throughfall.

key piece LWD – Defined in the Properly Functioning Condition Matrix, National Marine Fisheries Service, March 20, 1997 Attachment C. Based on Bilby and Ward 1989 and Fox 1994.

lacustrine deposit – Sediment deposited at the bottom of a lake; typically very fine-grained.

landform – Any physical, recognizable form or feature of the earth's surface, having a characteristic shape, and produced by natural processes.

landing – An area modified by equipment that is designed for accumulating logs before they are transported.

landscape – A particular part of the earth's surface, such as can be seen from a vantage point or examined on an aerial photo, and the various landforms and other physical features that together make up the field of view.

landslide – A general term for the downslope movement of large masses of earth material and the resulting landforms.

landslide headscarp – The relatively steep slope, commonly arcuate in plan, that forms the upper part of a landslide scar.

landslide headwall – See landslide headscarp.

landslide scar – The part of a slope exposed or visibly modified by detachment and downslope movement of a landslide. Usually lies upslope from the displaced landslide material. Commonly a steep, concave slope.

large woody debris (LWD) – Any large piece of woody material whose smallest diameter is >10 cm and whose length is >1 m.

large-scale map – Maps on which earth surface features appear relatively large; e.g., 1:10,000.

late successional – Forest stands that possess characteristics defined in the Properly Functioning Criteria Matrix (NMFS 1997) for riparian forest buffer.

Glossary

lays – A spot designated for a large tree to fall after being cut during timber harvest. Lays for large trees are often constructed by piling duff, soil, branches, etc., to make the landing of a falling tree softer so that the tree does not split.

LiDAR – Light Detection and Imaging remote sensing topographic mapping technology.

lithology – The characteristics of a rock. Commonly used to refer to rock type.

LWD – Large woody debris in and around channels.

macropore – Structural openings in the soil matrix, through which the movement of water is not affected by capillary action.

marginal information – Information such as scale, map legend, notes, magnetic declination, etc. that appears in the margin of a large map.

marginal notes – Text placed in the margin of a map or diagram.

marine materials – Sediments deposited in the ocean by settling from suspension and by submarine gravity flows, and sediments accumulated in the littoral zone due to wave action.

mass movement – A general term for downslope gravitational movement of earth materials by processes such as rockfall and debris slides.

mass wasting – A general term for the dislodgement and downslope transport of soil and rock under the direct application of gravitational stress (i.e., without major action of water, wind, or ice), a process that effects reduction of slopes and lowering of the land surface. See mass movement.

mass wasting – The generalized term for downslope movement of rock, soil, or debris; landslides.

matrix – The groundmass of smaller grains in which larger particles are supported.

meander bend – A curved portion of channel in an alluvial valley. It is implied that the position of the bend changes slowly over time, moving in the direction of the outside (convex) edge of the bend.

meandering channel – See meander bend. A reach of channel characterized by a series of meander bends.

median grain size – The sediment grain diameter in a distribution of sizes for a deposit of interest for which half of the grains are smaller and half of the grains are larger.

micropore – Openings in the soil matrix, through which the movement of water is subject to capillary action.

moderate slope – A planar surface sloping at 16 to 26° (28 to 50%).

moderately steep slope – A planar surface sloping at between 27 and 35° (51 to 70%).

morphology – The three-dimensional shape or geometry of a landform or other feature; shape or form of stream channels

Mylar – A semitransparent medium onto which maps are photographed and/or drafted; can be used to reproduce black- or blue-line copies of maps and diagrams; also used for overlays on aerial photos.

orographic effects – The effects of orography and mountains upon the passing flow of an air mass; precipitation that results from the lifting of moist air over a topographic barrier such as a mountain range. The precipitation may occur some distance upwind and a short distance downwind, as well as on the barrier feature.

orphan roads – Roads that are no longer used, often blocked to traffic, but that have not been decommissioned. These roads usually still have culverts and other drainage structures in place, but are no longer maintained.

outlet – Point where water exits from a stream, river, lake, reservoir, tidewater, or artificial drain. The mouth of a river where it flows into a larger body of water.

Glossary

outslope – To shape the road surface to direct water away from the cutslope side of the road.

overbank deposit – A sediment deposit outside of the bankfull channel; a flood-plain deposit.

overbank flooding – Flood flows that exceed the capacity of the active channel, overtop the channel banks, and occupy areas of the flood plain.

overland flow – Surface runoff produced as the result of (1) rainfall intensity exceeding the infiltration capacity of the land surface, or (2) the rise of the shallow water table to the land surface.

particle size analysis – Determination of the grain size composition of a sediment by laboratory analysis.

peak flow – The maximum instantaneous discharge of a stream or river at a given location. It usually occurs at or near the time of maximum stage.

pebble – A rock fragment between 2 and 64 mm intermediate diameter (Wentworth scale); a rounded rock fragment between 2 and 64 mm diameter.

pedologist – A scientist who studies the soil.

pedology – The science of the soil.

permeability – The capacity of porous rock, sediment, or soil for transmitting a fluid.

PFC – properly functioning condition (PFC), metrics for identifying conditions of preferred aquatic habitat.

physiography – Pertains to the factors that influence the development of landforms or a landscape, such as relief and topography, bedrock geology and structure, and geomorphological history.

pipeflow – The flow of water in a soil pipe. Soil pipes are interconnected large soil macropores (voids in the soil larger than 2 cm in diameter) that form shallow underground flow pathways.

plain – A level or very gently sloping planar surface with gradient up to 3° (5%)—local relief is less than 1 m; an extensive region of comparatively smooth and level or gently undulating land, having few or no prominent surface irregularities, and usually at a low elevation with reference to surrounding areas.

Pleistocene – An epoch of the Quaternary Period, after the Pliocene and before the Holocene, characterized by repeated glacial and nonglacial intervals; the corresponding worldwide series of rocks.

polygon boundary lines – The lines that delineate polygons on a terrain map or other map. Solid, dashed, and dotted lines are used to represent definite, indefinite, and assumed boundaries, respectively.

precipitation – The process by which atmospheric water becomes surface or subsurface water. The term “precipitation” is also commonly used to designate the quantity of water that is precipitated. Forms of precipitation include drizzle, rainfall, glaze, sleet, snow, graupel, small hail, and hail.

presentation map – The completed map in its final form.

presentation scale – The scale of the presentation map.

pretyping – The process of preliminary terrain mapping on aerial photos prior to fieldwork.

quadratic mean diameter (QMD) – Mean stem diameter of trees within a sample group. The formula for QMD is $d_q = \sqrt{\frac{\sum d_i^2}{N}}$ (where d is the diameter of the woody stems and N is the number of stems in the sample). Only stems >5 inches dbh are included in the calculation.

Quaternary deposits (materials) – Sediments deposited during the Quaternary Period. Similar to surficial materials.

Glossary

Quaternary Period – The most recent geological time period, subdivided into the Pleistocene and Holocene (Recent) Epochs. Currently defined as beginning about 1.6 million years ago.

rain-on-snow (ROS) zone – Area (generally defined as an elevation zone) where it is common for snow packs to be partially or completely melted during rainstorms several times during the winter.

raised delta – A delta now standing above the level of the water body into which it was deposited. Commonly resembles a terrace, with the terrace top marking the former water level.

rapid mass movement – Rapid downslope movement of earth material by falling, rolling, sliding or flowing. Includes rockfall, debris flows, and rapid landslides.

recurrence interval – The average time interval, usually in years, between the occurrence of a flood or other hydrologic event of a given magnitude or larger. The reciprocal, or inverse, of the recurrence interval is the probability (chance) of occurrence, in any year, of a flood equaling or exceeding a specified magnitude. For example, a flood that would be equaled or exceeded on the average of once in 100 years would have a recurrence interval of 100 years and a 0.01 probability, or 1 percent chance of occurring or being exceeded in any year.

regolith – The mantle of loose material that overlies bedrock. Includes weathered rock, soil, and surficial materials.

remote sensing – Data collection methods using interpretation of aerial photography or satellite imagery.

residual pool depth – The depth of a pool in a stream for which the depth of the pool outlet is subtracted; a standardized method of measuring pool depth independent of streamflow.

response potential – Likelihood of significant channel changes in reaction to changes in input variables.

response rating – In the WDNR method, the low, medium, or high sensitivity of a channel geomorphic unit to a changed input variable.

response reach – The segment of a stream where gradient is less than 3%; the segment of a stream that is effected most by sediment supply.

response variables – Characteristics of stream channel bed, banks, form, or flood plain that change in response to input variables.

response zones – Areas surrounding and including response reaches.

rheology – The study of the behavior of materials under stress. In geomorphology, the term refers to the composition and flow characteristics of debris flows and other sediment-laden flows.

ridges – Elongate hillocks with slopes dominantly between 15 and 35° (26 and 70%) on unconsolidated materials and steeper on bedrock. Local relief is greater than 1 m.

riffle – A shallow portion of a streambed where the flow is turbulent as it passes over a typically gravel–cobble deposit; typically located at the outlet of a pool.

rill erosion – Development of many closely spaced channels, caused by the removal of soil by concentrated overland flow; a form of surface erosion, intermediate between sheet erosion and gullying.

riparian – An area of land adjacent to a stream, river, lake or wetland that contains vegetation which, due to the presence of water, is distinctly different from the vegetation of adjacent upland areas.

Riparian Channel Unit (RCU) – The smallest length unit of stream distance distinguished when characterizing riparian condition for watershed analysis (not applicable to Timber Harvest Plans). Riparian species composition, tree density, and size regimes are similar within this length of riparian habitat. The width of the RCU is defined by the stream class and associated RMZ width identified in the Aquatic Conservation Plan.

river terrace – A more or less flat surface bounded downslope by a scarp and resulting from fluvial erosion and deposition. Same as fluvial terraces and alluvial terraces.

Glossary

road crossing – The location and means by which a road crosses over a stream.

road cutslope – The face of an excavated bank required to lower the natural ground line to the desired road profile.

road drainage system – A system designed to control the flow of water within a road prism.

road prism – The area of the ground containing the road surface, cutslope, and fillslope.

rolling – Elongate hillocks with slopes dominantly between 3 and 15° (5 and 26%) with local relief greater than 1 m.

roughness – See channel roughness.

routing – The derivation of an outflow hydrograph of a stream from known values of upstream inflow, using the wave velocity and/or the storage equation; a technique used to compute the effect of channel storage and translation on the shape and movement of a flood wave through a river reach.

runout area – The portion of a stream channel where a debris flow or debris torrent is deposited; for example, an alluvial fan.

sand – A detrital particle having a diameter in the range of 1/16 to 2 mm.

scarification – A method of seedbed preparation that consists of exposing patches of mineral soil through mechanical action.

scarp – See escarpment.

scour – The excavation of streambed material by elevated streamflow.

scour depth – The depth of excavation of streambed scour.

sediment budget – Accounting of the sources, movement, storage, and disposition of sediment produced by a variety of erosion processes, from its origin to its exit from a basin. Includes sediment types, amounts, and routing to specific locations of analysis.

sediment loading – The magnitude of sediment abundance or deposition.

sediment production – Occurs when sediment, colluvium, or bedrock is transported from hillslope to stream.

sediment regime – See erosional regime.

sediment supply – The availability of sediment transported from upstream to a point of interest.

sediment yield – The total sediment outflow from a catchment over some unit of time.

seepage zone – An area where soil is saturated due to emerging groundwater.

segment clustering – The process by which stream segments are grouped together into strata that represent significantly different channel morphology and/or response potential.

seismic – Pertaining to earthquakes.

seismic zonation – Broad subdivision of a province or country into regions of similar susceptibility to earthquakes; subdivision of an area according to types of surface materials and their properties with regard to seismic shaking, location of faults, etc. Commonly termed micro-zonation.

shear resistance – The force produced by surface-layer deposits that is exerted on the water flowing over them.

shear stress – The downslope component of force of the fluid weight exerted on the streambed.

sheet erosion – Removal (more or less evenly) of surface material from sloping land, by the action of broad sheets of overland flow; a form of surface erosion.

side-channel – A portion of the stream channel separate from the main flow path of the stream.

silt – A detrital particle having a diameter in the range of 0.004 to 0.0625 mm.

Glossary

silviculture – The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

simple terrain unit/polygon – A terrain polygon consisting of a single type of basic element; a single type of terrain (e.g., “colluvial veneer”).

sinuosity – The ratio of channel length to valley length.

skid trails – A pathway traveled by ground skidding equipment while moving trees or logs to a landing. The tractor or rubber-tired skidder generally drags the cut trees behind it to the landing. A skid trail differs from a skid road in that stumps are cut very low and the ground surface is mainly untouched by the blades of earth-moving machines.

slash – the residual cut vegetation (tree limbs, etc.) left on the ground as a result of forest and other vegetation being altered by forest practices or other land use activities.

slope break – The point on a slope where gradient changes rather abruptly.

slope failure – Rupture and collapse, or flow, of surficial materials, soil, or bedrock due to shear stress exceeding the shear strength of the material.

slope processes – Mass movement processes, such as debris slides, and surface wash whereby fine sediments are transported downslope by overland flow.

slope stability – Pertains to the susceptibility of slope to landslides and the likelihood of slope failure.

slope wash – Fine sediments, on or at the foot of hillsides, that have been moved downslope by overland flow.

slow mass movement – Slow, usually imperceptible, downslope movement of masses of surficial material or bedrock by creeping, flowing, or sliding; slow slope failure.

slumping – The downslope movement of earth materials along a curved failure plane.

small-scale maps – Maps on which earth surface features appear relatively small; e.g., 1:250,000.

snow pack – A field of naturally packed snow that ordinarily melts slowly during the early summer months.

snow-water equivalent (SWE) – Amount of liquid water (expressed as depth) derived by a melting snow pack.

soil – The natural medium for growth of land plants; the result of the combined effects of physical, chemical, and biological processes.

soil creep – The gradual, steady downhill movement of soil and loose rock material on a slope.

soil drainage – Refers to the rapidity and extent of water removal from the soil in relation to additions, especially by surface runoff and by percolation downward through the soil.

soil horizon – A zone in the soil that is generally parallel to the land surface and distinguished from zones above and below by characteristic physical properties, such as color, structure and texture, and soil chemistry.

soil moisture – The water content of the soil in its natural state.

soil pipes – Generally synonymous with macropores.

soil pit – A pit excavated for the purpose of examining the soil. Most commonly dug by hand using shovels, and usually less than 1 m deep.

soil surveys – Mapping the distribution of soil types (requires aerial photo interpretation and fieldwork by pedologists); assessing the engineering properties of surficial materials, such as bearing strength and plasticity, at a site or in an area where construction is proposed; collecting soil or surficial material samples for geochemical analysis for the purposes of mineral exploration.

Glossary

sorting – A geological term pertaining to the variability of particle sizes in a clastic sediment or sedimentary rock. Materials with a wide range of particle sizes are termed “poorly sorted”; material with a small range of sizes is “well sorted.” (Note that these terms are the reverse of the engineering expressions “well graded” and “poorly graded.”)

source reach – The segment of a stream where gradient is greater than 20%; the segment of a stream where the majority of colluvium is stored.

steep slope – A planar surface steeper than about 35° (70%).

stereopair – Two adjacent photos from a flight line. Can be viewed simultaneously under a stereoscope to obtain a three-dimensional image.

stereoscope – An instrument used for obtaining a three-dimensional view of overlapping pairs of aerial photos.

stereoscopic field of view – The overlapping parts of a stereopair that can be seen in three dimensions under a stereoscope.

stream channel – Streambed and banks formed by fluvial processes. Landslides located in stream channels typically occur in headwaters of steep class 3 streams.

streambed material – Generally the sediment stored in the channel bed.

streamside slope – Hillslopes between 50% and 64% and located below the last major break-in-slope leading to a watercourse.

subsurface flow – Water that infiltrates the soil surface and moves laterally through the upper soil layers until it enters a channel.

surface erosion – Movement of soil particles down or across a slope, as a result of exposure to gravity and a moving medium such as rain or wind. The transport rate of sediment depends on the steepness of the slope, the texture and cohesion of the soil particles, and the activity of rainsplash, sheetwash, gullyng, and dry ravel processes.

surface expression – Refers to small topographic features and landforms that are not usually shown adequately on a topographic map, and to the relation of a surficial material to the underlying surface.

surface runoff – That part of the runoff which travels over the soil surface to the nearest stream channel; that part of the runoff of a drainage basin that has not passed beneath the surface since precipitation. Also applies to snow-melt or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions.

surficial deposits (materials) – Relatively young, nonlithified sediments, usually of Quaternary age. Usually classified as to their genesis; hence fluvial sediments, colluvium, glaciolacustrine sediments, etc.

surficial geology – Geology of surficial deposits.

survey intensity (level) – Expresses the relation between map scale and the amount of field-verifying carried out during preparation of a terrain map.

Sustained Yield Plan – refers to the “Final Environmental Impact Statement/Environmental Impact Report and Habitat Conservation Plan/Sustained Yield Plan for the Headwaters Forest Project” January 1999.

swale – An unchanneled hillslope with concave topographic form where subsurface flow is concentrated. Swales are often sites of accumulation of colluvium.

tension cracks – Open fissures in bedrock or surficial materials resulting from tensile stress. Typically located at or near the crest of a steep slope, and indicative of potential slope failure.

terrace – Any relatively level or gently inclined surface, generally less broad than a plain, and bounded along one side by a steeper descending slope or scarp and along the other by a steeper ascending slope or scarp.

terraced – Either one or several step-like forms, each consisting of a scarp face and a horizontal or gently inclined tread upslope.

Glossary

terrain – A comprehensive term to describe a tract of landscape being studied with respect to its natural features; pertains to maps showing surficial materials, material texture, surface expression, present-day geomorphological (geological) processes, and related features.

Terrain Classification System – A classification of surficial materials, their texture, surface expression, present-day geomorphological (geological) processes, and other features, used for mapping.

terrain database – Terrain map information and related additional information stored in digital form. May also apply to information on maps and in notebooks.

terrain features – Landforms and related phenomena, such as striations, gravel pits, and fossil sites, shown on a terrain map by on-site symbols.

terrain legend – The legend of a terrain map. Usually the symbols for surficial materials, their texture, surface expression, present-day geomorphological (geological) processes, and other features are defined individually.

terrain map – A map showing surficial materials, their texture, surface expression, present-day geomorphological (geological) processes, and other features.

terrain polygon – The area enclosed by a boundary line on a terrain map; the basic mapping unit.

terrain stability – See slope stability.

terrain unit – See terrain polygon.

texture of sediments – Pertains to the grain sizes, shape, and arrangement of particles in a sedimentary unit.

transport capacity – In fluvial geomorphology, this refers to potential sediment transport by fluvial processes in a given stream reach, segment, or cross section.

transport reach – The segment of a stream where gradient is between 3% and 20%; the segment of a stream that rapidly transports sediment downstream.

traverse – A survey line. Applied to various kinds of surveys, including topographic, geological, soil, and biological surveys.

tree throw – Trees uprooted and toppled by the wind.

turbidity – A condition in which suspended matter causes water to become cloudy or opaque.

undulating – Gently sloping hillocks and hollows with multidirectional slopes generally up to 15° (26%). Local relief is greater than 1 m.

Unified Soil Classification System – Soil classification used by engineers. Based on particle size of coarse materials and consistency of fines (silt/clay mixtures).

UTM – Universal Transverse Mercator grid. Present on most topographic maps and used for quantitative description of locations.

valley slope – The gradient of slope along the axis of a valley floor as distinguished from the channel slope, which is generally less than the valley slope.

vener – A thin mantle of surficial material that does not mask the topographic irregularities of the surface upon which it rests. Ranges in thickness from 10 cm to about 1 m.

wash load – The part of the total stream load that is carried for a considerable time in suspension, free from contact with the stream bed. It consists mainly of clay and silt.

water table – The upper surface of the zone of groundwater saturation in permeable rocks or surficial materials.

water yield – Runoff, including groundwater outflow that appears in the stream, plus groundwater outflow that leaves the basin underground. Water yield is the precipitation minus the evapotranspiration.

waterbar – A shallow ditch excavated across a road at an angle to prevent excess surface-water flow down the road surface and subsequent erosion of road surface materials; a small excavation across a road to collect and divert roadway surface-water flow.

Glossary

watershed – All lands enclosed by a continuous hydrologic drainage divide and lying upslope from a specified point on a stream. Also referred to as the drainage basin.

weathered bedrock – Bedrock that has decomposed or disintegrated in situ due to mechanical and/or chemical weathering.

Wentworth particle size scale – A logarithmic scale for size classification of sediment particles. Defines terms such as silt, pebbles, and boulders.

wood loading – The magnitude of LWD abundance or deposition.

yarding – in logging, the hauling of felled timber to the landing or temporary storage site from where trucks (usually) transport it to the mill site. Yarding methods include cable yarding, ground skidding, and aerial methods such as helicopter and balloon yarding.

yarding systems – Methods for moving timber from the sites where the trees are felled to sites where they are loaded onto logging trucks. Includes high lead, skyline, ground skidding, and so on.

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