SECTION A
MASS WASTING

INTRODUCTION

This module summarizes the methods and results of a mass wasting assessment conducted on the Mendocino Redwood Company, LLC (MRC) ownership in the Albion River watershed, the Albion Watershed Analysis Unit (Albion WAU). California Planning Watersheds included in the Albion WAU include portions of the Lower Albion (AL), Middle Albion (AM), South Fork Albion (AS), Upper Albion (AU), and Little River (AR). This assessment is part of a watershed analysis initiated by MRC and utilizes modified methodology adapted from procedures outlined in the Standard Methodology for Conducting Watershed Analysis (Version 4.0, Washington Forest Practices Board).

The principle objectives of this assessment are to:

1) Identify the types of mass wasting processes active in the basin.
2) Identify the link between mass wasting and forest management related activities.
3) Identify where the mass wasting processes are concentrated.
4) Partition the ownership into terrain units of relative mass wasting potential based on the likelihood of future mass wasting and sediment delivery to stream channels.

Additionally, the role of mass wasting sediment input to watercourses is examined. This information combined with the results of the Surface and Fluvial Erosion module is used to construct a sediment input summary for the Albion WAU, contained in the Sediment Input Summary section of this watershed analysis.

The products of this report are: a landslide inventory map (Map A-1), a terrain unit (TU) map (Map A-2), and a mass wasting inventory database (Appendix A). The assembled information will enable forestland managers to make better forest management decisions to reduce management-induced risk of mass wasting. The mass wasting inventory will provide the information necessary to understand the spatial distribution, causal mechanisms, relative size, and timing of mass wasting processes active in the basin with reasonable confidence.

LANDSLIDE TYPES AND PROCESSES IN THE ALBION WAU

The terminology used to describe landslides in this report closely follows the definitions of Cruden and Varnes (1996). This terminology is based on two nouns, the first describing the material that the landslide is composed of and the second describing the type of movement. Landslides identified in the Albion WAU were described using the following names: debris slides, debris torrents, debris flows, and rockslides. These names are described in Cruden and Varnes (1996) with the exception of our use of debris torrent.

Shallow-Seated Landslides

Debris slides, debris flows, and debris torrents are terms used throughout Mendocino Redwood Company's ownership to identify shallow-seated landslide processes. The material composition of debris slides, flows, or torrents is considered to be soil with a significant proportion of coarse material; 20 to 80 percent of the particles are larger than 2 mm (Cruden and Varnes, 1996). Shallow-seated slides generally move quickly downslope and commonly break apart during failure. Shallow-seated slides commonly occur in converging topography where colluvial materials accumulate and subsurface drainage concentrates. Susceptibility of a slope to fail by shallow-seated landslides is affected by slope steepness, saturation of soil, soil strength (friction angle and cohesion), and root strength. Due to the shallow depth and fact that debris slides, flows, or torrents involve the soil mantle, these are landslide types that can be significantly influenced by forest practices.

Debris slides are the most common landslide type observed in the WAU. The landslide mass typically fails along a surface of rupture or along relatively thin zones of intense shear strain located near the base of the soil profile. The landslide deposit commonly slides a distance beyond the toe of the surface of rupture and onto the ground surface below the failure; it generally does not slide more than the distance equal to the length of the failure scar. Landslides with deposits that traveled a longer distance below the failure scar would likely be defined as a debris flow or debris torrent. Debris slides commonly occur on steep planar slopes, convergent slopes, along forest roads and on steep slopes adjacent to watercourses. They usually fail by translational movement along an undulating or planar surface of failure. By definition debris slides do not continue downstream upon reaching a watercourse.

A debris flow is similar to a debris slide with the exception that the landslide mass continues to "flow" down the slope below the failure a considerable distance on top of the ground surface. A debris flow is characterized as a mobile, potentially rapid, slurry of soil, rock, vegetation, and water. High water content is needed for this process to occur. Debris flows generally occur on both steep, planar hillslopes and confined, convergent hillslopes. Often a failure will initiate as a debris slide, but will change as its moves downslope to a debris flow.

Debris torrents have the greatest potential to destroy stream habitat and deliver large amounts of sediment. The main characteristic distinguishing a debris torrent is that the mass of failed soil and debris "torrents" downstream in a confined channel and erodes the channel. As the debris torrent moves downslope and scours the channel, the liquefied landslide material increases in mass. Highly saturated soil or run-off in a channel is required for this process to occur. Debris torrents move rapidly and can potentially run down a channel for great distances. They typically initiate in headwall swales and torrent down intermittent watercourses. Often a failure will initiate as a debris slide, but will develop into a debris torrent upon reaching a channel. While actually a combination of two processes, these features were considered debris torrents.

Deep-Seated Landslides

Rockslides and earthflows are terms used throughout Mendocino Redwood Company's ownership to identify deep-seated landslide processes. The only deep-seated landslide process identified in the Albion WAU was rockslides. No earth flows were observed. The failure dates of the rockslides could not be estimated with any confidence and the rockslides are likely to be of varying age with some potentially being over 10,000 years old. Many of the rockslides are considered "dormant", but the importance of identifying those lies in the fact that if reactivated, they have the potential to deliver large amounts of sediment and impair stream habitat. Accelerated or episodic movement in some rockslides is likely to have occurred over time in response to seismic shaking or high rainfall events. Rockslides can be very large, exceeding tens to hundreds of acres.

Rockslides are deep-seated landslides with movement involving a relatively intact mass of rock and overlying earth materials. The failure plane is below the colluvial layer and involves the underlying bedrock. Mode of rock sliding generally is not strictly rotational or translational, but involves some component of each. Rotational slides typically fail along a concave surface, while translational slides typically fail on a planar or undulating surface of rupture. Rockslides commonly create a flat, or back-tilted, bench below the crown of the scarp. A prominent bench is usually preserved over time and can be indicative of a rockslide. Rockslides fail in response to triggering mechanisms such as seismic shaking, adverse local structural geology, high rainfall, offloading or loading material on the slide, or channel incision (Wieczorek, 1996). The stream itself can be the cause of chronic movement, if it periodically undercuts the toe of a rockslide.

Use of SHALSTAB by Mendocino Redwood Company for the Albion WAU

SHALSTAB, a coupled steady state runoff and infinite-slope stability model, is used by MRC as one tool to demonstrate the relative potential for shallow-landslide hazard across the MRC ownership (Dietrich and Montgomery, 1998). A validation study of the SHALSTAB model is presented by Dietrich and others (1998). In the watershed analysis, mass wasting hazard is expanded beyond SHALSTAB. Areas of mass wasting and sediment delivery hazards are mapped using field and aerial photograph interpretation techniques. However, SHALSTAB output was used to assist in this interpretation of the landscape and terrain units.

METHODS

Landslide Inventory

The mass wasting assessment relies on an inventory of mass wasting features collected through the use of aerial photographs and field observations. MRC owned photographs from 2000 (color), 1996 (color), and 1987 (black and white) were used to interpret landslides. The three sets of photographs are all at a scale of 1:12,000. MRC collected data regarding characteristics and measurements of the identified landslides. We acknowledge that some landslides may have been missed, particularly small ones that may be obscured by vegetation. A brief description of select parameters inventoried for each landslide observed in the field and during aerial photograph interpretation is presented in Figure A-1. A detailed discussion of these parameters follows.

Figure A-1. Description of Select Parameters used to describe Mass Wasting in the Mass Wasting Inventory.

- Slide Identification: Each landslide is assigned a unique identification number, a two letter code (see below) that denotes which planning watershed (PWS) the slide is located, and a number which indicates the USGS designated map section number the slide is mapped in.
  - Planning Watershed Codes:
  - AR - Little River
  - AL - Lower Albion River
  - AM - Middle Albion River
  - AS - South Fork Albion River
  - WU - Upper Albion River
- TU # – terrain unit in which landslide is located.
- Landslide Type:
  - DS - debris slide
  - DF - debris flow
  - DT - debris torrent
  - RS - rockslide

- Certainty: The certainty of identification is recorded.
  - D - Definite
  - P - Probable
  - Q - Questionable
- Physical Characteristics: Includes average length, width, depth, and volume of individual slides. Length of torrent, if present, is recorded.
- Sediment Routing: Denotes the type of stream the sediment was routed into.
  - P - Perennial
  - I - Intermittent or Ephemeral
  - N - no sediment delivered
- Sediment Delivery: Quantification of the relative percentage of the landslide volume and mass delivered to the stream.
- Slope: Percent slope angle is recorded for all shallow-seated landslides observed in the field.
- Age: Relative age of the observed slide is estimated.
  - A - active (<5 years old)
  - R - recent (5-10 years old)
  - O - old (>10 years old)
- Slope Form: Denotes morphology of the slope where the landslide originated
  - C - concave
  - D - divergent
  - P - planar
- Slide Location: Interpretation of the location where the landslide originated
  - H - Headwall Swale
  - S - Steep Streamside Slopes
  - I - Inner Gorge
  - N – Neither
- Road Association: Denotes the association of the landslide to land-use practices.
  - R - Road
  - S - Skid Trail
  - L - Landing
  - N - Neither
  - I - Indeterminate
- Deep-seated landslides morphologic descriptions: toe, body, lateral scarps, and main scarp (see section below on Systematic Description of Deep-seated Landslide Features).

Landslides identified in the field and from aerial photograph observations are plotted on a landslide inventory map (Map A-1). All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide feature (body and scarp). Physical and geomorphic characteristics of all inventoried landslides are categorized in a database in Appendix A. Landslide dimensions and depths can be quite variable, therefore length, width, and depth values that are recorded are considered to be the average dimension of that feature. When converting landslide volumes to mass (tons), we assume a soil bulk density of 1.35 grams/cubic centimeter (100 lbs/ft^3).

The certainty of landslide identification is assessed for each landslide. Three designations are used: definite, probable, and questionable. Definite means the landslide definitely exists. Probable means the landslide probably is there, but there is some doubt in the analyst's interpretation. Questionable means that the interpretation of the landslide identification may be inaccurate; the analyst has the least amount of confidence in the interpretation. Accuracy in identifying landslides on aerial photographs is dependent on the size of the slide, scale of the photographs, thickness of canopy, and logging history. Landslides mapped in areas recently logged or through a thin canopy are identified with the highest level of confidence. Characteristics of the particular aerial photographs used affects confidence in identifying landslides. For example, sun angle creates shadows which may obscure landslides, the print quality of some photo sets varies, and photographs taken at small scale makes identifying small landslides difficult. The landslide inventory results are considered a minimum estimate of sediment production. This is because landslides that were too small to identify on aerial photographs may have been missed, landslide surfaces could have reactivated in subsequent years and not been quantified, and secondary erosion by rills and gullies on slide surfaces is difficult to assess.

Two techniques were employed in order to extrapolate a sediment volume delivery percentage to landslides not visited in the field. Landslides that were determined to be directly adjacent to a watercourse from topographic maps and aerial photograph interpretation were assigned 100% delivery. Landslides that were determined to deliver, but were not directly adjacent to a watercourse, were assigned the mean delivery percentage from landslides observed in the field.

Landslides were classified based on the likelihood that a road associated land use practice was associated with the landslide. In this analysis, the effects of silvicultural techniques were not observed. The Albion WAU has been managed, recently and historically, for timber production. Therefore, it was determined that the effect of silvicultural practices was too difficult to confidently assign to landslides. There have been too many different silvicultural activities over time for reasonable confidence in a landslide evaluation based on silviculture. The land use practices that were assigned to landslides were associations with roads, skid trails, or landings. It was assumed that a landslide adjacent to a road, landing, or skid trail was triggered either directly or indirectly by that land use practice. If a landslide appeared to be influenced by more than one land use practice, the more causative one was noted. If a cutslope failure did not cross the road prism, it was assumed that the failure would remain perched on the road, landing, or skid trail and would not deliver to a watercourse. Some surface erosion could result from a cutslope failure and is assumed to be addressed in the road surface erosion estimates (Surface and Fluvial Erosion Module).

Sediment Input from Shallow-Seated Landslides

The overall time period used for mass wasting interpretation and sediment budget analysis is twenty-three years. Sediment input to stream channels by mass wasting is quantified for three time periods (1977-1987, 1988-1996, 1997-2000). The evaluation assumes that the last 10 years of mass wasting can be observed in the aerial photograph. This is due to landslide surfaces re-vegetating quickly, making mass wasting features older than about 10 years difficult to see. We acknowledge that we have likely missed some small mass wasting events during the aerial photograph interpretation. However, we assume we have captured the majority of the larger mass wasting events in this analysis.

Sediment delivery estimates from mapped shallow-seated landslides were used to produce the total mass wasting sediment input. In order to extrapolate depth to the shallow-seated landslides not visited in the field, an average was taken from the measured depths of landslides visited in the field. In order to extrapolate sediment delivery percentage to landslides not verified in the field, an average was taken from the estimated delivery percentage of field verified landslides. Delivery statistics were not calculated for deep-seated landslides.

Some of the sediment delivery from shallow-seated landslides is the result of conditions created by deep-seated landslides. For example, a deep-seated failure could result in a debris slide or torrent, which could deliver sediment. Furthermore, over-steepened scarps or toes of deep-seated landslides may have shallow failures associated with them. These types of sediment delivery from shallow-seated landslides associated with deep-seated landslides are accounted for in the delivery estimates.

Sediment Input from Deep-Seated Landslides

Large, active, deep-seated landslides can potentially deliver large volumes of sediment. Delivery generally occurs over long time periods compared to shallow-seated landslides, with movement delivering earth materials into the channel, resulting in an increased sediment load downstream of the failure. Actual delivery can occur by over-steepening of the toe of the slide and subsequent failure into the creek, or by the slide pushing out into the creek. It is very important not to confuse normal stream bank erosion at the toe of a slide as an indicator of movement of that slide. Before making such a connection, the slide surface should be carefully explored for evidence of significant movement, such as wide ground cracks. Sediment delivery could also occur in a catastrophic manner. In such a situation, large portions of the landslide essentially fail and move into the watercourse “instantaneously”. These types of deep-seated failures are relatively rare on MRC property and usually occur in response to unusual storm events or seismic ground shaking.

Movement of deep-seated landslides has definitely resulted in some sediment delivery in the Albion WAU. Quantification of the sediment delivery from deep-seated landslides was not determined in this watershed analysis. Factors such as rate of movement, or depth to the slide plane, are difficult to determine without subsurface geotechnical investigations that were not conducted in this analysis. Sediment delivery to watercourses from deep-seated landslides (landslides typically $\geq$10 feet thick) can occur by several processes. Such processes can include surface erosion and shallow-or deep-seated movement of a portion or all of the deep-seated landslide deposit.

The ground surface of a deep-seated landslide, like any other hillside surface, is subject to surface erosion processes such as rain drop impact, sheet wash (overland flow), and gully/rill erosion. Under these conditions the sediment delivery from surficial processes is assumed the same as adjacent hillside slopes not underlain by landslide deposits. The materials within the landslide are disturbed and can be arguably somewhat weaker. However, once a soil has developed, the fact that the slope is underlain by a deep-seated landslide should make little difference regarding sediment delivery generated by erosional processes that act at the ground surface. Although fresh, unprotected surfaces that develop in response to recent or active movement could become a source of sediment until the bare surface becomes covered with leaf litter, re-vegetated, or soils developed.

Clearly, movement of a portion or all of a deep-seated landslide can result in delivery of sediment to a watercourse. This determination is made by exploring for any evidence of movement. However, movement would need to be on slopes immediately adjacent to or in close proximity to a watercourse and of sufficient magnitude to push the toe of the slide into the watercourse. A deep-seated slide that toes out on a slope far from a creek or moves only a short distance downslope will generally deliver little to a watercourse. It is also important to realize that often only a portion of a deep-seated slide may become active, though the portion could be quite variable in size. Ground cracking at the head of a large, deep-seated landslide does not necessarily equate to immediate sediment delivery at the toe of the landslide. Movement of large deep-seated landslides can create void spaces within the slide mass. Though movement can be clearly indicated by the ground cracks, many times the toe may not respond or show indications of movement until some of the void space is “closed up”. This would be particularly true in the case of very large deep-seated landslides that exhibit ground cracks that are only a few inches to a couple of feet wide. Compared to the entire length of the slide, the amount of movement implied by the ground crack could be very small. This combined with the closing up or “bulking up” of the slide, would not generate much movement, if any, at the toe of the slide. Significant movement, represented by large wide ground cracks, would need to occur to result in significant movement and sediment delivery at the toe of the slide.

Systematic Description of Deep-seated Landslide Features

The characteristics of deep-seated landslides received less attention in the landslide inventory than shallow-seated landslides mainly due to the fact that subsurface analyses would have to be conducted to estimate attributes such as depth, volume, failure date, current activity, and sediment delivery. Subsurface investigation was beyond the scope of this report. Few of the mapped deep-seated landslides were observed to have recent movement associated with them, mainly due to oversteepening of the slope at the toe or scarp. Further assessment of deep-seated landslides will occur on a site-by-site basis in the Albion WAU, likely during timber harvest plan preparation and review.

Deep-seated landslides were only interpreted by reconnaissance techniques (aerial photograph interpretation rather than field observations). Reconnaissance mapping criteria consist of observations of four morphologic features of deep seated landslides --toe, internal morphology, lateral flanks, main scarp--and vegetation (after McCalpin 1984 as presented by Keaton and DeGraff, 1996, p. 186, Table 9-1). The mapping and classification criteria for each feature are presented in detail below.

Aerial photo interpretation of deep seated landslide features in the Albion WAU suggests that the first three morphologic features above are the most useful for inferring the presence of deep-seated landslides. The presence of tension cracks and/or sharply defined and topographically offset scarps are probably a more accurate indicator of recent or active landslide movement. These features, however, are rarely visible on aerial photos.

Sets of five descriptions have been developed to classify each deep-seated landslide morphologic feature or vegetation influence. The five descriptions are ranked in descending order from characteristics more typical of active landslides to dormant to relict landslides. One description should characterize the feature most accurately. Nevertheless, some overlap between classifications is neither unusual nor unexpected. We recognize that some deep-seated landslides may lack evidence with respect to one or more of the observable features, but show strong evidence of another feature. If there is no expression of a particular geomorphic feature (e.g. lateral flanks), the classification of that feature is considered “undetermined”. If a deep-seated landslide is associated with other deep-seated landslides, it may also be classified as a landslide complex.

In addition to the classification criteria specific to the deep-seated landslide features, more general classification of the strength of the interpretation of the deep-seated landslide is conducted. Some landslides are obscured by vegetation to varying degrees, with areas that are clearly visible and areas that are poorly visible. In addition, weathering and erosion processes may also obscure geomorphic features over time. The quality of different aerial photograph sets varies and can sometimes make interpretations difficult. Owing to these circumstances, each inferred deep-seated landslide feature is classified according to the strength of the evidence as definite, probable or questionable as defined with respect to interpretation of shallow landslides.

At the project scale (THP development and planning), field observations of deep-seated landslide morphology and other indicators by qualified professionals are expected to be used to reduce uncertainty of interpretation inherent in reconnaissance mapping. Field criteria for mapping deep-seated landslides and assessment of activity are presented elsewhere.

Deep Seated Landslide Morphologic Classification Criteria:

I. Toe Activity

1. Steep streamside slopes with extensive unvegetated to sparsely vegetated debris slide scars. Debris slides occur on both sides of stream channel, but more prominently on side containing the deep-seated landslide. Stream channel in toe region may contain coarser sediment than adjacent channel. Stream channel may be pushed out by toe. Toe may be eroding, sharp topography/geomorphology.
2. Steep streamside slopes with few unvegetated to sparsely vegetated debris slide scars. Debris slides generally are distinguishable only on streamside slope containing the deep-seated landslide. Stream channel may be pushed out by toe. Sharp edges becoming subdued.
3. Steep streamside slopes that are predominantly vegetated with little to no debris slide activity. Topography/geomorphology subdued.
4. Gently sloping stream banks that are vegetated and lack debris slide activity. Topography/geomorphology very subdued.
5. Undetermined

II. Internal Morphology

1. Multiple, well defined scarps and associated angular benches. Some benches may be rotated against scarps so that their surfaces slope back into the hill causing ponded water, which can be identified by different vegetation than adjacent areas. Hummocky topography with ground cracks. Jack-strawed trees may be present. No drainage to chaotic drainage/disrupted drainage.
2. Hummocky topography with identifiable scarps and benches, but those features have been smoothed. Undrained to drained but somewhat subdued depressions may exist. Poorly established drainage.
3. Slight benches can be identified, but are subtle and not prominent. Undrained depressions have since been drained. Moderately developed drainage to established drainage but not strongly incised. Subdued depressions but are being filled.
4. Smooth topography. Body of slide typically appears to have failed as one large coherent mass, rather than broken and fragmented. Developed drainage well established, incised. Essentially only large undrained depressions preserved and would be very subdued. Could have standing water. May appear as amphitheater slope where slide deposit is mostly or all removed.
5. Undetermined

III. Lateral Flanks

1. Sharp, well defined. Debris slides on lateral scarps fail onto body of slide. Gullies/drainage may begin to form at boundary between lateral scarps and sides of slide deposit. Bare spots are common or partially unvegetated.
2. Sharp to somewhat subdued, rounded, essentially continuous, might have small breaks; gullies/drainage may be developing down lateral edges of slide body. May have debris slide activity, but less prominent. Few bare spots.
3. Smooth, subdued, but can be discontinuous and vegetated. Drainage may begin to develop along boundary between lateral scarp and slide body. Tributaries to drainage extend onto body of slide.
4. Subtle, well subdued to indistinguishable, discontinuous. Vegetation is identical to adjacent areas. Watercourses could be well incised, may have developed along boundary between lateral scarp and slide body. Tributaries to drainage developed on slide body.
5. Undetermined

IV. Main Scarp

1. Sharp, continuous geomorphic expression, usually arcuate break in slope with bare spots to unvegetated; often has debris slide activity.
2. Distinct, essentially continuous break in slope that may be smooth to slightly subdued in parts and sharp in others, apparent lack of debris slide activity. Bare spots may exist, but are few.
3. Smooth, subdued, less distinct break in slope with generally similar vegetation relative to adjacent areas. Bare spots are essentially non-existent.
4. Very subtle to subdued, well vegetated, can be discontinuous and deeply incised, dissected; feature may be indistinct.
5. Undetermined

V. Vegetation

1. Less dense vegetation than adjacent areas. Recent slide scarps and deposits leave many bare areas. Bare areas also due to lack of vegetative ability to root in unstable soils. Open canopy, may have jack-strawed trees; can have large openings.
2. Bare areas exist with some regrowth. Regrowth or successional patterns related to scarps and deposits. May have some openings in canopy or young broad-leaf vegetation with similar age.
3. Subtle differences from surrounding areas. Slightly less dense and different type vegetation. Essentially closed canopy; may have moderately aged to old trees.
4. Same size, type, and density as surrounding areas.
5. Undetermined

Terrain Units

Terrain units (TUs) are delineated by partitioning the landscape into zones characterized by similar geomorphic attributes, shallow-seated landslide potential, and sediment delivery to stream channels. A combination of aerial photograph interpretation, field investigation, and SHALSTAB output were utilized to delineate TUs. The TU designations for the Albion WAU are only meant to be general characterizations of similar geomorphic and terrain characteristics related to shallow seated landslides. Deep-seated landslides are also shown on the TU map (Map

A-2). The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review. The landscape and geomorphic setting in the Albion WAU is certainly more complex than generalized TUs delineated for this evaluation. The TUs are only meant to be a starting point for gauging the need for site-specific field assessments.

The delineation of each TU described is based on landforms present, the mass wasting processes, sensitivity to forest practices, mass wasting hazard, delivery potential, and forest management related trigger mechanisms for shallow seated landslides. The landform section of the TU description defines the terrain found within the TU. The mass wasting process section is a summary of landslide types found in the TU. Sensitivity to forest practice and mass wasting hazard is, in part, a subjective call by the analyst based on the relative landslide hazard and influence of forest practices. Delivery potential is based on proximity of TU to watercourses and the likelihood of mass wasting in the unit to reach a watercourse. The hazard potential is based on a combination of the mass wasting hazard and delivery potential (Table A-1). The trigger mechanisms are a list of forest management practices that may have the potential to create mass wasting in the TU.

Table A-1. Ratings for Potential Hazard of Delivery of Debris and Sediment to Streams by Mass Wasting (L= low hazard, M= moderate hazard, H = high hazard)(from Version 4.0, Washington Forest Practices Board, 1995).

		Mass Wasting Potential		
		Low	Moderate	High
Delivery Potential	Low	**L**	**L**	**M**
	Moderate	**L**	**M**	**H**
	High	**L**	**M**	**H**

RESULTS

Mass Wasting Inventory

A Landslide Inventory Data Sheet (Appendix A) was used to record attributes associated with each landslide. The spatial distribution and location of landslides is shown on Map A-1.

A total of 270 shallow-seated landslides (debris slides, torrents, or flows) were identified and characterized in the Albion WAU. A total of 136 deep-seated landslides (rockslides) were mapped in the Albion WAU. A considerable effort was made to field verify as many landslides as possible to insure greater confidence in the results. Approximately 36% of the identified shallow-seated landslides were field verified. From this level of field observations, extrapolation of landslide depth and sediment delivery is assumed to be performed with a reasonable level of confidence.

The temporal distribution of the 270 shallow-seated landslides observed in the Albion WAU is listed in Table A-2. The distribution by landslide type is shown in Table A-3.

Table A-2. Shallow-Seated Landslide Summary for Albion WAU by Time Periods.

Planning Watershed	1977 - 1987 Landslides	1988 - 1996 Landslides	1997 – 2000 Landslides
Little River	0	16	0
Lower Albion River	15	54	17
South Fork Albion River	16	50	26
Middle Albion River	5	52	14
Upper Albion River	4	0	1

Table A-3. Landslide Summary by Type and Planning Watershed for Albion WAU.

Planning Watershed	Debris Slides	Debris Flows	Debris Torrents	Rockslides	Total	Road Assoc.
Little River	16	0	0	5	21	3
Lower Albion River	76	5	5	40	126	21
South Fork Albion River	73	14	5	42	134	39
Middle Albion River	67	4	0	43	114	20
Upper Albion River	3	2	0	6	11	1

The majority of landslides observed in the Albion WAU are debris slides and rockslides. Only a few of the rock slides are likely to be active in the Albion WAU, the remaining are most likely dormant features. Of the 270 shallow-seated landslides in the Albion WAU, 84 are determined to be road-associated. This is approximately 31% of the total number of shallow-seated landslides. There were 35 debris torrents and flows observed in the Albion WAU. This is approximately 13 percent of the total shallow landslides observed in the Albion WAU.

Of the field observed shallow-seated landslides, 94% were initiated on slopes of 60% gradient or higher. Six shallow-seated landslides occurred on slopes with gradients less than 60%. Of those six, only two were not road associated. The majority of inventoried landslides originated in convergent topography where subsurface water tends to concentrate; or on steep, planar topography where sub-surface water can be concentrated at the base of slopes, in localized topographic depressions, or by local geologic structure. Few landslides originated in divergent topography, where subsurface water is routed to the sides of ridges. Such observations were, in part, the basis for the delineation of the Albion WAU into Terrain units.

Terrain Units

The landscape was partitioned into five Terrain units (TU) representing general areas of similar geomorphology, landslide processes, and sediment delivery potential for shallow-seated landslides (Map A-2). The units are to be used by forest managers to assist in making decisions that will minimize future mass wasting sediment input to watercourses. The delineation for the TUs was based on qualitative observations and interpretations from aerial photographs, field evaluation, and SHALSTAB output. Deep-seated landslides are also shown on the TU map (Map A-2). The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review.

Shallow-seated landslide characteristics considered in determination of map units are size, frequency, delivery to watercourses, and spatial distribution. Hillslope characteristics considered are slope form (convergence, divergence, planar), slope gradient, magnitude of stream incision, and overall geomorphology. The range of slope gradients was determined from USGS 1:24000 topographic maps and field observations. Hillslope and landslide morphology vary within each individual Terrain unit and the boundaries are not exact. This evaluation is not intended to be a substitute for site-specific field assessments. Site-specific field assessments will still be required in TUs and at deep-seated landslides or specific areas of some TUs to assess the risk and likelihood of mass wasting impacts from a proposed management action. The Terrain units are compiled on the entitled Terrain unit Map (Map A-2).

TU Number: 1

Description: Inner Gorge or Steep Streamside Slopes adjacent to Low Gradient Watercourses

Materials: Shallow soils formed on weathered marine sedimentary rocks. May be composed of toe sediment of deep-seated landslide deposit.

Landform: Characterized by steep streamside slopes or inner gorge topography along low gradient watercourses (typically less than 6-7%). An inner gorge is a geomorphic feature created from down cutting of the stream, generally in response to tectonic uplift. Inner gorge slopes extend from either one or both sides of the stream channel to the first break in slope. Inner gorge slope gradients typically exceed 70%, although slopes with lower inclination are locally present. Length of inner gorge slopes range from approximately 20 to 150 feet in the Albion WAU. Inner gorge slopes commonly contain areas of multiple, coalescing shallow seated landslide scars of varying age. Steep streamside slopes are characterized by their lack of a prominent break in slope. Slopes are generally planar in form with slope gradients typically exceeding 70% and exhibit evidence of past landslide activity. The upper extent of TU 1 is variable. Where there is not a break in slope, the unit may extend 100 feet upslope (based on the range of lengths of landslides observed, 20-100 feet). Landslides in this unit generally deposit sediment directly into Class I and II streams. Small areas of incised terraces may be locally present.

Slope: Typically >65 %, (mean slope of observed mass wasting events is 85%, range is 73%-102%)

Total Area: 416 acres; 3% of the total WAU area.

MW Processes: 6 *road-associated landslides*

- 6 Debris slides
- 0 Debris flow
- 0 Debris torrent

10 non-road associated landslides

- 10 Debris slides
- 0 Debris torrent
- 0 Debris flows

Non Road-related Landslide Density: 0.02 landslides per acre for the past 23 years.

Forest Practices Sensitivity: High sensitivity to road construction due to proximity to watercourses, high sensitivity to harvesting and forest management practices due to steep slopes with localized colluvial or alluvial soil deposits adjacent to watercourses.

Mass Wasting Potential: High localized potential for landslides in both unmanaged and managed conditions.

Delivery Potential: High

Delivery Criteria Used: Steep slopes adjacent to stream channels, a majority of the observed landslides delivered sediment into streams.

Hazard-Potential Rating: **High**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides or flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides or flows in this unit.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides or flows in this unit.
- Cut-slope of skid trails can remove support of slope creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows and over-steepening TU 1 slopes.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: High confidence for susceptibility of landslides and sediment delivery in this unit. Moderate confidence in placement of the unit boundary. This unit is locally variable and exact boundaries are best determined during field observations. Within this unit there are likely areas of low gradient slopes that are less susceptible to mass wasting.

TU Number: 2

Description: Steep streamside slopes or inner gorge topography adjacent to high gradient intermittent or ephemeral watercourses.

Materials: Shallow soils formed from weathered marine sedimentary rocks with localized areas of thin to thick colluvial deposits.

Landforms: Characterized by steep streamside slopes or inner gorge topography along low gradient watercourses (typically greater than 6-7%). An inner gorge is a geomorphic feature created from down cutting of the stream, generally in response to tectonic uplift. Inner gorge slopes extend from either one or both sides of the stream channel to the first break in slope. Inner gorge slope gradients typically exceed 70%, although slopes with lower inclination are locally present. Length of inner gorge slopes range from approximately 20 to 150 feet in the Albion WAU. Inner gorge slopes commonly contain areas of multiple, coalescing shallow seated landslide scars of varying age. Steep streamside slopes are characterized by their lack of a prominent break in slope. Slopes are generally planar in form with slope gradients typically exceeding 70% and exhibit evidence of past landslide activity. The upper extent of TU 2 is variable. Where there is not a break in slope, the unit may extend 150 feet upslope (based on the range of lengths of landslides observed, 16-150 feet). Landslides in this unit generally deposit sediment directly into Class II and III streams.

Slope: Typically >65% (mean slope of observed mass wasting events is 78%, range is 52%-95%).

Total Area: 1013 acres; 6% of total WAU area

MW Processes: *7 road-associated landslides*

- 4 Debris slides
- 2 Debris flow
- 1 Debris torrent

40 non-road associated landslides

- 39 Debris slides
- 1 Debris flow
- 0 Debris torrent

Non Road-related Landslide Density: 0.04 landslides per acre for the past 23 years.

Forest Practices Sensitivity: High sensitivity to roads due to steep slopes adjacent to watercourses, high to moderate sensitivity to harvesting and forest management due to steep slopes next to watercourses. Localized areas of steeper and/or convergent slopes may have an even higher sensitivity to forest practices.

Mass Wasting Potential:	High in both unmanaged and managed conditions due to the steep morphology of the slope.
Delivery Potential:	High
Delivery Criteria Used:	Steep slopes adjacent to stream channels, a majority of the observed landslides delivered sediment into streams.
Hazard-Potential Rating:	**High**
Forest Management Related Trigger Mechanisms:	•Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit. •Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit. •Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit. •Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit. •Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows. •Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows. •Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows. •Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit. •Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows. •Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit. •Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.
Confidence:	High confidence for susceptibility of unit to landslides and sediment delivery. Moderate confidence in the placement of this unit. This unit is highly localized and exact boundaries are better determined from field observations. Within this unit there are likely areas of low gradient slopes that are less susceptible to mass wasting.

TU Number: 3

Description: Dissected and convergent topography

Materials: Shallow soils formed from weathered marine sedimentary rocks with localized thin to thick colluvial deposits.

Landforms: These areas have steep slopes (typically greater than 60%) that have been sculpted over geologic time by repeated debris slide events. The area is characterized primarily by 1) steep convergent and dissected topography located within steep gradient collivial hollows or headwall swales and small high gradient watercourses, and 2) local very steep planar slopes, where there is strong evidence of past shallow landslide failures. MRC intends this unit to represent areas of potential high to moderate high risk for shallow landslides that does not constitute a continuous streamside unit (otherwise it would classify as TU 1 or 2). The mapped unit may represent isolated individual "high risk" areas or areas where there is a concentration of "high risk" areas. Boundaries between higher hazard areas and other more stable areas (i.e. divergent and lower gradient slopes) within the unit should be keyed out as necessary based on field observation of landslide features.

Slope: Typically >65%, (mean slope of observed mass wasting events is 73%, range is 54%-102%)

Total Area: 953 ac., 6% of the total WAU

MW Processes: 16 *road associated landslides*

- 12 Debris slides
- 3 Debris flow
- 1 Debris Torrent

62 non-road associated landslides

- 50 Debris slides
- 8 Debris flow
- 4 debris torrent

Non Road-related Landslide Density: 0.07 landslides per acre for the past 23 years.

Forest Practices Sensitivity: Moderate to high sensitivity to road building, moderate to high sensitivity to harvesting and forest management practices due to moderately steep slopes within this unit. Localized areas of steeper and/or convergent slopes have even higher sensitivity to forest practices.

Mass Wasting Potential: High

Delivery Potential: Moderate

Delivery Criteria Used: The converging topography directs mass wasting down slopes toward watercourses. Delivery potential may be high based on relatively high number of debris slides. Landslides in headwater swales often torrent or flow down watercourses. Approximately 68% of landslides in this unit delivered sediment.

Hazard-Potential Rating: **High**

Forest Management Related Trigger Mechanisms:

- Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit.
- Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows in this unit.
- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows.
- Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit.
- Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows.
- Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: Moderate confidence in placement of unit. This unit is locally variable and exact boundaries are best determined from field observations. Some areas within this unit could have higher susceptibility to landslides and higher delivery rates due to localized areas of steep slopes with weak earth materials, and unusually adverse ground water conditions.

TU Number: 4

Description: Non-dissected topography

Materials: Shallow to moderately deep soils formed from weathered marine sedimentary rocks.

Landforms: Moderate to moderately steep hillslopes with planar, divergent, or broadly convergent slope forms with isolated areas of steep topography or strongly convergent slope forms. Unit 4 is generally a midslope region of lesser slope gradient and more variable slope form than unit 3.

Slope: Typically 40% - 65%, (mean slope of observed mass wasting events is 74%, range is 46% - 95%)

Total Area: 11590 acres, 75% of the total WAU

MW Processes: *56 road-associated landslides*

- 48 Debris slides
- 6 Debris flow
- 2 Debris torrent

70 non-road associated landslides

- 63 Debris slides
- 5 Debris flow
- 2 Debris Torrents

Non Road-related Landslide Density: 0.006 landslides per acre for the past 23 years.

Forest Practices Sensitivity: Moderate sensitivity to road building, moderate to low sensitivity to harvesting and forest management practices due to moderate slope gradients and non-converging topography within this unit. Localized areas of steeper slopes have higher sensitivity to forest practices.

Mass Wasting Potential: Moderate

Delivery Potential: High

Delivery Criteria Used: This unit has the largest area, which accounts for it having the highest number of landslides. This unit has a low landslide density, and therefore has a moderate mass wasting hazard. Although the landslides in this unit are highly localized, when landslides occur, the landslide has a high potential to deliver. Approximately 66% of the landslides in this unit delivered sediment. This unit has a moderate sensitivity to road building due low road landslide density.

Hazard-Potential Rating: **Moderate**

Forest Management Related Trigger Mechanisms:

- •Sidecast fill material placed on steep slopes can initiate debris slides, torrents or flows in this unit.
- •Concentrated drainage from roads onto unstable areas can initiate debris slides, torrents or flows in this unit.
- •Concentrated drainage from roads can increase groundwater, accelerating movement of rockslides or earth flows in this unit.
- •Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- •Cut-slope of roads can expose potential failure planes creating debris slides, torrents or flows in this unit.
- •Cut-slope of roads can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- •Concentrated drainage from skid trails onto unstable areas can initiate debris slides, torrents or flows.
- •Cut-slope of skid trails can expose potential failure planes creating debris slides, torrents or flows in this unit.
- •Cut-slope of skid trails can remove support of the toe or expose potential failure planes of rockslides or earth flows.
- •Sidecast fill material created from skid trail construction placed on steep slopes can initiate debris slides, torrents or flows.
- •Removal of vegetation from these slopes can result in loss of evapotranspiration and thus increase pore water pressures that could initiate slope failure in this unit.
- •Post timber harvest root decay of hardwood or non-redwood conifer species can be a contributing factor in the initiation of debris slides, torrents or flows in this unit.

Confidence: High confidence in placement of unit, however, this unit is locally variable and exact boundaries are best determined from field observations. Some areas within this unit could have higher susceptibility to landslides and higher delivery rates due to localized areas of steep slopes with weak soils, and adverse groundwater conditions.

TU Number: 5

Description: Low relief topography

Material: Moderately deep to deep soils, derived from weathered marine sedimentary rocks.

Landforms: Characterized by low gradient slopes generally less than 40%, although in some places slopes can be steeper. This unit occurs on ridge crests, low gradient side slopes, and well-developed terraces. Shallow-seated landslides seldom occur and usually do not deliver sediment to stream channels.

Slope: Typically <40% (based on field observations)

Total Area: 1513 acres, 10% of WAU area

MW Processes: 3 *road-associated landslides*

- 3 Debris slides

Non Road-related Landslide Density: 0 landslides per acre for past 32 years.

Forest Practices Sensitivity: Low sensitivity to road building and forest management practices due to low gradient slopes

Mass Wasting Potential: Low

Delivery Potential: Low

Delivery Criteria Used: Sediment delivery in this unit is low.

Hazard-Potential Rating: **Low**

Forest Management Related Trigger Mechanisms:

- Poorly sized culvert or excessive debris at watercourse crossings can initiate failure of the fill material creating debris slides, torrents or flows in this unit.
- Concentrated drainage from roads and skid trails can initiate or accelerate gully erosion, which can increase the potential for mass wasting processes.

Confidence: High confidence in placement of unit in areas of obviously stable topography. High confidence in mass wasting potential and sediment delivery potential ratings.

Sediment Input from Mass Wasting

Sediment delivery was estimated for shallow-seated landslides in the Albion WAU. Depth values were estimated to facilitate approximation of mass for the landslides not observed in the field. In order to extrapolate depth to the shallow-seated landslides not visited in the field, an average was taken from the measured depths of landslides visited in the field. The mean depth of all shallow-seated landslides interpreted as being unrelated to road systems was 4 feet. The mean depth of all shallow seated landslides interpreted as being associated with road systems was 5.5 feet. Due to the relative lack of debris flows and torrents, no effort was made to differentiate landslide depths among different shallow landslide types. The mean depths of 4 feet for non road related landslides, and 5.5 feet for road related landslides, were assigned to all landslides not verified in the field.

Landslides that were determined to be immediately adjacent to a watercourse, from topographic maps and aerial photograph interpretation, were assigned 100% sediment delivery. The mean sediment delivery percentage assigned to shallow landslides determined to deliver sediment, but not visited in the field, is approximately 88%. Of the 270 shallow-seated landslides mapped by MRC in this watershed analysis, 197 of the landslides delivered some amount of sediment (Table A-4).

Table A-4. Total Shallow-Seated Landslides Mapped for each PWS in AlbionWAU.

Planning Watershed	Total Landslides	Landslides with Sediment Delivery	Landslides with No Sediment Delivery
Little River	16	12	4
Lower Albion River	86	59	27
South Fork Albion River	92	72	20
Middle Albion River	71	51	20
Upper Albion River	5	3	2
sum	***270***	***197***	***73***
Percentage	***100%***	***73%***	***27%***

Mass wasting was separated into three time periods for analysis: 1977-1987, 1988-1996, and 1997-2000. The dates for each of the time periods are based on the date of aerial photographs used to interpret landslides (1987, 1996, and 2000) and field observations (1998 and 2003). The available aerial photography did not correspond to ten year time periods for mass wasting assessment; however the time periods and the aerial photographs analyzed approximate decadal intervals. These time periods allow for a general evaluation of the relative magnitude of sediment delivery rate estimates across the Albion WAU.

A total of 185,000 tons of mass wasting sediment delivery was estimated for the time period 1977-2000 in the Albion WAU. This equates to approximately 335 tons/sq. mi./yr. Of the total estimated amount, 30,000 tons (16% of total) occurred from 1977-1987, 113,000 tons (61% of total) occurred from 1988-1996, and 42,000 tons (23% of total) occurred in the 1996-2000 time period (Table A-5).

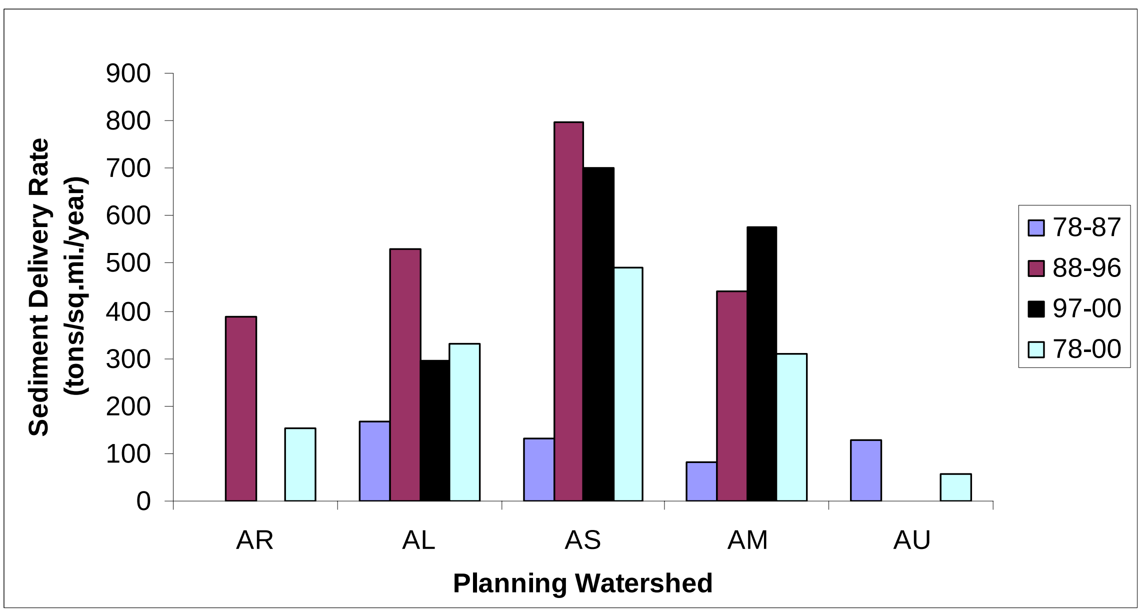
Table A-5. Sediment Delivery by Time Period for Albion WAU (displayed in tons rounded to 100 tons).

Planning Watershed	1977 - 1987	1988 – 1996	1997 – 2000
Little River	0	3,200	0
Lower Albion River	11,800	33,700	8,200
South Fork Albion River	9,700	52,800	20,400
Middle Albion River	4,700	23,300	13,400
Upper Albion River	3,700	0	0
Total	***30,000***	***113,000***	***42,000***

Relatively large amounts of sediment delivered from 1988-2000 compared to earlier time periods results from several factors, including high rain fall events during this time frame, and field work conducted in the summer of 1998. Unusually intense storms and/or high annual rainfall occurred in 1995, 1997 and 1998; landslides are commonly triggered under wet climatic conditions. According to rainfall data collected at the Caspar Creek Experimental Watershed approximately 10 miles north of Albion, the most intense rainfall events during the 1995 – 1998 time period were January 8-9 1995 5.78 inches, March 13-14 1995 4.64 inches, December 30 1996 – January 1 1997 10.58 inches and March 21-23 1998 6.63 inches. Field surveys located additional landslides; approximately 20% of the estimated sediment delivery was from landslides discovered in the field. Field work conducted in 2003 was mainly focused on the TU boundaries and the deep-seated landslide inventory, not the shallow-seated landslide inventory.

The sediment delivery rates in the Albion WAU planning watersheds changes dramatically over the time period investigated (Chart A-1).

Chart A-1. Mass Wasting Sediment Input Rate (tons/sq. mi./year) from Landslides for MRC Ownership in Albion Shown by Watershed and Time Period.



The highest overall sediment input from mass wasting occurred in the South Fork Albion planning watershed (490 tons/sq. mi./yr over the 23 year period). The higher sediment delivery appears to be due to a large amount of landslides that occurred on roads adjacent to watercourses, and more generally steeper and dissected terrain. In contrast, the Upper Albion (60 tons/sq. mi./yr) and Little River (150 tons/sq. mi./yr) planning watersheds had a relatively small sediment delivery rate over the 23 year period; however, MRC ownership is relatively small in these planning watersheds (21% of the Upper Albion is in MRC ownership, while only 8% of Little River is in MRC ownership. Of the planning watersheds where MRC owns a majority of the acreage, the Lower Albion has the lowest mass wasting input. The smaller estimated sediment input for the Lower Albion is partly attributed to a larger proportion of relatively gentle terrain within this planning watershed; however, one landslide contributed nearly 35% of the estimated sediment delivered over the entire 23 years.

Road associated mass wasting was found to have contributed 97,000 tons (170 tons/sq. mi./yr) of sediment over the 23 years analyzed in the Albion WAU (Table A-6). This represents approximately 52% of the total mass wasting inputs for the Albion WAU for 1977-2000. In the South Fork Albion planning watershed, road associated landslide sediment delivery was a major sediment source, contributing 72% of the sediment delivered into the South Fork Albion planning watershed.

Table A-6. Road Associated Sediment Delivery for Shallow-Seated Landslides for Albion WAU by Planning Watershed.

Planning Watershed	Road Associated Mass Wasting Sediment Delivery (rounded to 100 tons)	Percent of Total Sediment Delivery From Planning Watershed
Little River	1,900	61%
Lower Albion River	13,000	24%
South Fork Albion River	60,000	72%
Middle Albion River	19,000	46%
Upper Albion River	2,800	75%
Total	***97,000***	***52%***

Sediment Input by Terrain unit

Total mass wasting sediment delivery for the Albion WAU was separated into respective terrain units. Sediment delivery statistics for each TU are summarized in Table A-7. It should be noted that not all planning watersheds contain all five TUs.

The terrain unit with the highest sediment delivery is TU 4, which is estimated to deliver 54% of the total sediment input for the Albion WAU. This is partly due to the high road density within this unit which makes the actual hazard of the unit appear artificially high; 53% of the total delivered sediment in TU 4 came from road related features. Combining all high hazard units (TU 1, 2, 3) would yield 47% of the estimated non-road related sediment input off only 15% of the MRC owned acreage. Combining the moderate and low hazard units (TU 4 and 5) would yield 53% of the estimated non-road related sediment input off the remaining 85% of the property. However, the non-road sediment delivery from TU 4 is largely influenced by one particular landslide which delivered approximately 40% of the estimated sediment for the entire

23 year period of analysis. One measure of the intensity of mass wasting processes in a TU is the amount of sediment produced divided by the area in the TU. The last row in Table A-7 expresses landslide intensity as the ratio of the percentage of total sediment delivered by the percentage of watershed area in the TU. High values of this ratio indicate high landslide rates in a concentrated area. The TU with the largest ratio was unit 3 with a ratio of 4.8. The smallest ratios are found in units 5 and 4, 0.1 and 0.7, respectively.

Table A-7. Total Sediment Delivery by Terrain units in the Albion WAU, 1978-2003 (rounded to nearest 100 tons).

TU	1	2	3	4	5
Road Related Sediment Delivered (tons)	3,500	9,500	28,100	53,500	2,200
Non-Road Related Sediment Delivered (tons)	1,900	13,300	25,800	47,200	0
Total Sediment Delivered (tons)	5,400	22,800	53,900	100,700	2,200
% road related delivery	4%	10%	29%	55%	2%
% non-road related delivery	2%	15%	29%	53%	0%
% of total delivered	3%	12%	29%	54%	1%
% of Watershed	3%	6%	6%	75%	10%
% ratio: delivery %/area %	1.0	2.0	4.8	0.7	0.1

CONCLUSIONS

In the case of the landslides observed in the Albion WAU, landslides greater than 300 cubic yards in size represented over 91% of the sediment delivery estimated. Landslides greater than 200 and 100 cubic yards in size represented approximately 95% and 99%, respectively of the sediment delivery estimated.

In forest environments of the California Coast Range, mass wasting is a common, natural occurrence. In the Albion WAU this is due to steep slopes, the condition of weathered and intensely sheared and fractured marine sedimentary rocks, seismic activity, locally thick colluvial soils, a history of timber harvest practices, and the occurrence of high intensity rainfall events. Mass wasting events are episodic and many landslides may happen in a short time frame. Mass wasting features of variable age and stability are observed throughout the Albion WAU. The vast majority of the landslides visited in the field during this assessment occurred on slopes greater than 60%. Seeps and springs were evident in the evacuated cavity at many sites. Particular caution should be exercised when conducting any type of forest management activity in areas with convergent or locally steep topography.

The steep streamside areas of TU 1, 2, and 3 contribute the highest amount of the sediment per unit area in the watershed. In the moderate and low hazard units of TU 4 and 5, a large amount of road associated landslides are occurring, suggesting the need to make improvements on roads within the Albion WAU. One large landslide in TU 4 accounted for 40% of the estimated non-road sediment delivered, demonstrating the effect of large landslides on sediment delivery estimates.

Approximately 31% of the shallow-seated landslides inventoried in the Albion WAU are road associated. Road associated mass wasting represented 52% of the estimated sediment delivery. Road construction is thus a significant factor in the cause of shallow-seated mass wasting events. Improved road construction practices combined with design upgrades of old roads can reduce anthropogenic sediment input rates and mass wasting hazards.

Mass wasting sediment input is estimated to be at least 340 tons/sq. mi./yr. over the 1977-2000 time period for the entire Albion WAU. Overall in the Albion WAU, sediment delivery from mass wasting was highest in the South Fork Albion planning watershed (490 tons/sq. mi./yr). Road related landslides adjacent to watercourses, and steep dissected terrain, are at least partly the reason for the high sediment delivery.

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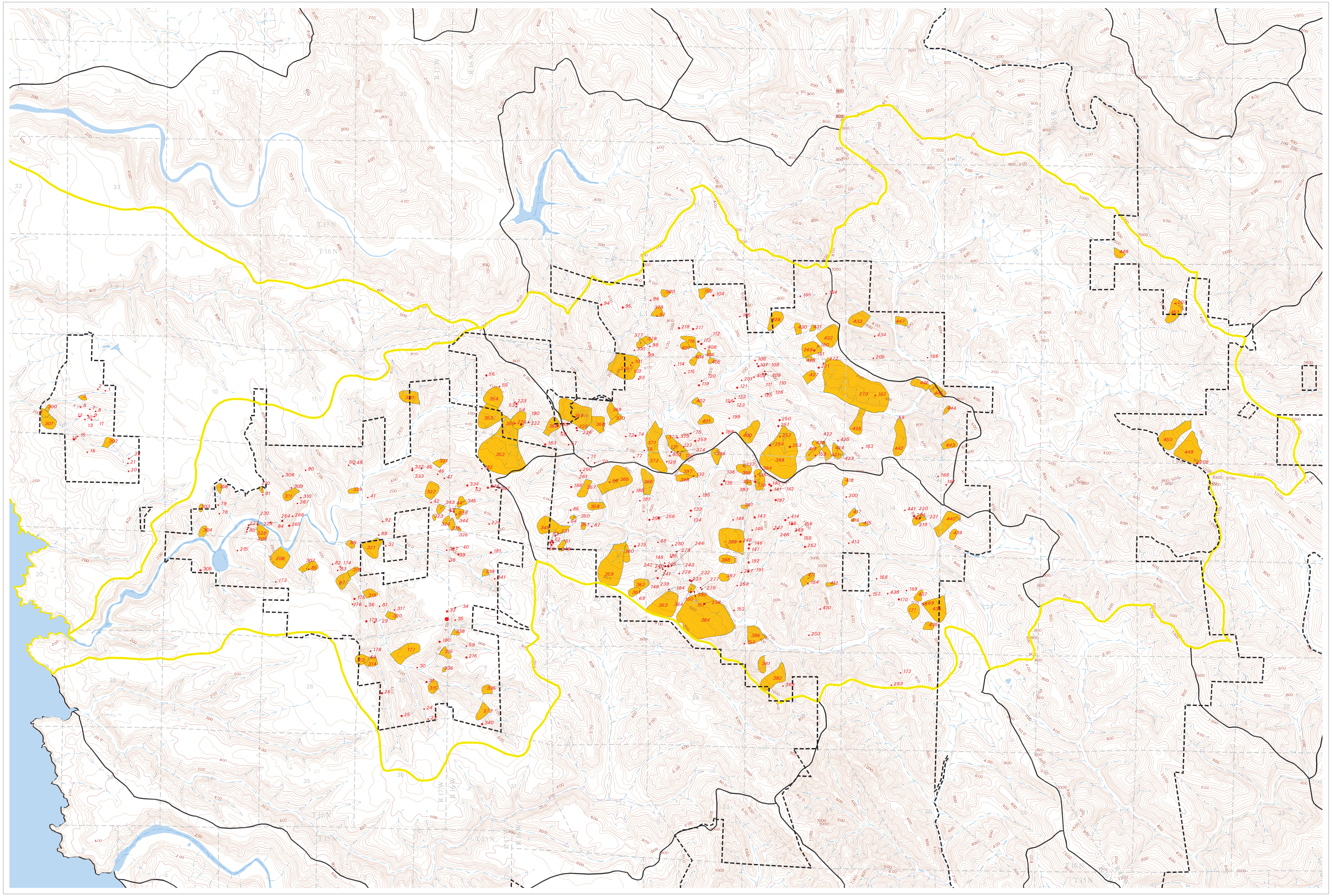
Albion Mass Wasting Inventory
Appendix A



Albion River Watershed Analysis Unit

Map A-1 Mass Wasting Inventory

This map presents the location of mass wasting features identified on the MRC land in the Albion River watershed. The mass wasting features were developed from an interpretation of aerial photographs from the 1980's-2000 with field observations taken in 1998 and 2003. All shallow-seated landslides are identified as a point plotted on the map at the interpreted head scarp of the failure. Deep-seated landslides are represented as a polygon representing the interpreted perimeter of the landslide feature. Physical and geomorphic characteristics of the landslides are categorized in a database in the mass wasting section of the Albion River watershed analysis.

Deep-Seated Landslides

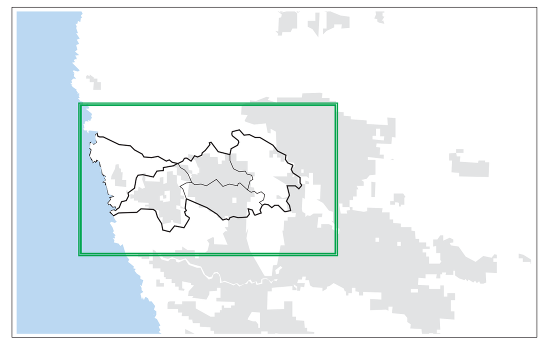
Shallow-Seated Landslides
- < 500 cubic yards
- 500 - 5000 cubic yards
- > 5000 cubic yards

MRC Ownership

Planning Watershed Boundary

Albion River Watershed Boundary

Flow Class
- Class I
- Class II
- Class III



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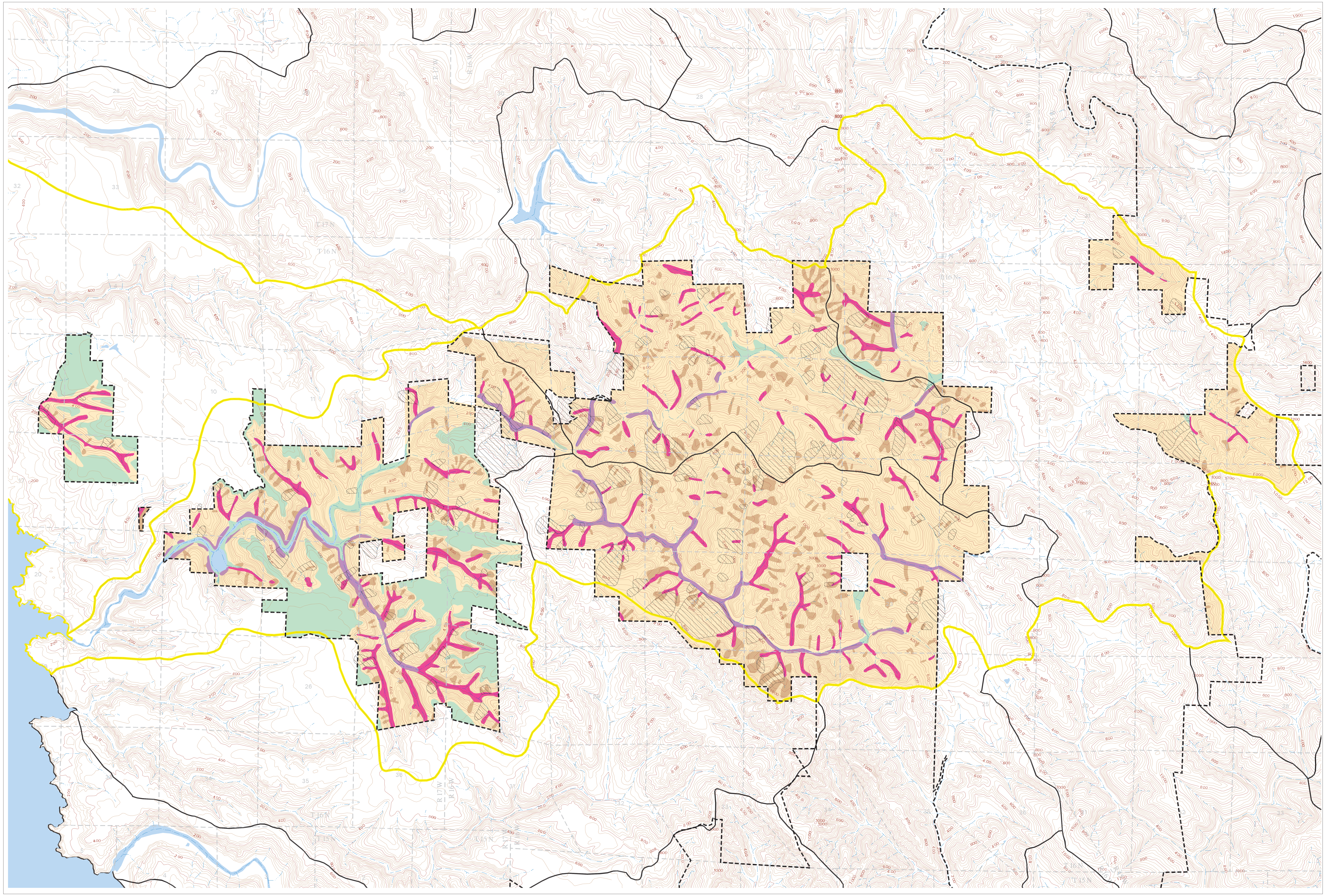


Albion River Watershed Analysis Unit

Map A-2
Terrain Stability Units

This map presents an interpretation of the terrain stability units (TSUs, formerly known as mass wasting map units) delineated for the Albion WAU. The TSUs characterize the landscape by similar geomorphic attributes, shallow-seated landslide potential, and sediment delivery potential. The TSU designations for the Albion WAU are only meant to be general characterizations of similar geomorphic and terrain characteristics related to shallow-seated landslides. Deep-seated landslides are also shown on this map. The deep-seated landslides have been included to provide land managers with supplemental information to guide evaluation of harvest planning and subsequent needs for geologic review. The landscape and geomorphic setting in the Albion WAU is certainly more complex than generalized TSUs delineated for this evaluation. The TSUs are only meant to be a starting point for gauging the need for site-specific field assessments. Field observations will over-ride unit boundaries of this map.

Unit 1: Inner Gorge or Steep Slopes adjacent to Low Gradient Watercourses

Unit 2: Steep slopes or inner gorge topography adjacent to select intermittent or ephemeral watercourses

Unit 3: Dissected and convergent topography

Unit 4: Non-dissected topography

Unit 5: Low relief topography

Deep Seated Landslides

MRC Ownership

Planning Watershed Boundary

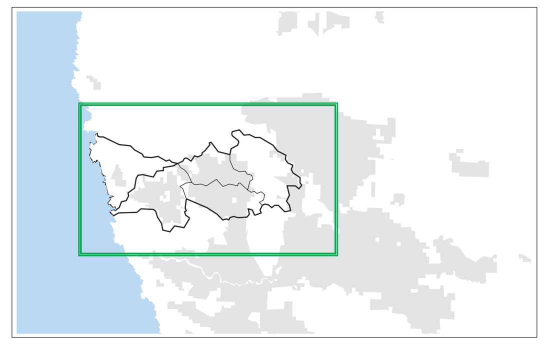
Albion River Watershed Boundary

Flow Class

Class I

Class II

Class III



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June 2004

Watershed: Albion

Mass Wasting Inventory Sheet
Mendocino Redwood Company, LLC

ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide	Certainty	Size			Slide	Sed.	Sed. Del.	Sed.	Sed.	Slope	Age	Slope	Slide	Road	Toe	Body	Lat.	Main	DS	Complex	Field	Comments
													Shallow-seated landslides								*Deep-seated landslides*							
						Type		Length	Width	Depth	Vol.	Routing	Ratio	Delivery	Delivery	(field)		Form	Loc.	Assoc.	Activity	Morph.	Scarps	Scarps	Veg.		Obs.	
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
1	AR	9	1996	2-10	2	DS	D	80	30	4	356	I	88	313	422													
2	AR	9	1996	2-10	4	DS	D	64	20	4	190	I	50	95	128													
3	AR	9	2000	2-3	NA	RS	D	300	240			P									3	3	4	2	4	N		
4	AR	8	2000	2-3	NA	RS	D	240	600			P									4	3	4	2	4	Y		adjacent to #301
6	AR	9	1996	2-10	4	DS	D	64	16	4	152	I	88	133	180													cable yarding trail
7	AR	9	1996	2-10	4	DS	P	48	16	4	114	I	88	100	135													cable yarding trail
8	AR	9	1996	2-10	4	DS	P	48	16	4	114	I	88	100	135													cable yarding trail
9	AR	9	1996	2-10	4	DS	D	32	16	4	76	I	88	67	90													
10	AR	9	1996	2-10	2	DS	P	0	0	0	0	N																
11	AR	9	1996	2-10	4	DS	D	80	32	4	379	I	100	379	512					R								
12	AR	9	1996	2-10	2	DS	P	80	32	4	379	I	100	379	512					R								
13	AR	9	1996	2-10	2	DS	Q	16	16	4	38	N																
14	AR	16	1996	2-10	5	DS	D	96	48	4	683	I	100	683	922					R								
15	AR	16	1996	2-10	2	DS	Q	16	16	4	38	I	100	38	51													on stream channel
16	AR	16	1996	2-11	3	DS	P	16	16	4	38	N																
20	AR	16	1996	2-11	2	DS	Q	16	16	4	38	I	88	33	45													
21	AR	16	1996	2-11	2	DS	D	16	16	4	38	I	100	38	51													
22	AR	16	1996	2-11	4	DS	D	16	16	4	38	N																
23	AL	25	1996	5-16	2	DS	P	32	16	4	76	N																
24	AL	25	1996	5-16	2	DS	Q	48	64	4	455	I	88	400	541													
25	AL	25	1996	5-16	4	DS	D	128	48	4	910	I	88	801	1081													
26	AL	25	1987	M14B-16	2	DS	Q	112	48	4	796	I	100	796	1075													
29	AL	24	1996	5-17	3	DS	Q	32	16	4	76	N																
30	AL	25	1996	5-16	1	DS	D	48	16	4	114	P	100	114	154													
31	AL	25	1996	5-16	4	DF	D	192	32	5.5	1252	P	100	1252	1690					R								
32	AL	24	1996	6-24	4	DF	D	300	100	25	27778	I	50	13889	18750	83	A										Y	
33	AL	24	1996	6-24	5	DS	D	125	40	5	926	I	100	926	1250	78				R							Y	scarp close to road (downslope)
34	AL	19	1996	6-24	4	DS	D	80	25	4	296	I	100	296	400	65											Y	borders grove
35	AL	19	1996	6-24	4	DS	Q	16	16	4	38	N																
36	AL	24	1996	5-18	1	DS	P	32	80	4	379	I	100	379	512													amphitheater slope
37	AL	24	1996	5-18	4	DS	P	48	32	4	228	N																looks weathered
38	AL	19	1996	6-25	2	DS	P	48	16	4	114	I	88	100	135													looks weathered
39	AL	19	1996	6-25	3	DS	D	112	32	4	531	I	88	467	631													
40	AL	19	1996	6-25	3	DS	D	16	32	4	76	I	88	67	90													
41	AL	13	1996	5-19	4	DS	P	80	32	4	379	N																
42	AL	13	1996	5-19	2	DS	P	48	32	4	228	I	100	228	307													
43	AL	18	1996	5-19	2	DS	D	96	20	4	284	I	88	250	338													
44	AL	18	1996	5-19	4	DS	D	80	32	4	379	I	88	334	451													in steep gully
45	AL	13	1996	5-19	3	DS	D	64	48	4	455	N																
46	AL	13	1996	5-19	3	DS	P	32	16	4	76	I	88	67	90													amphitheater topography
47	AL	13	1996	5-19	3	DS	Q	48	16	4	114	I	88	100	135													amphitheater topography
48	AL	14	1996	4-15	2	DS	D	45	25	3	125	I	100	125	169	68											Y	headward erosion
50	AL	14	1996	4-15	2	DS	D	40	35	4	207	I	100	207	280	65											Y	amphitheater topography
52	AL	18	1996	6-26	4	DS	P	32	16	4	76	N																
53	AL	7	1996	6-27	2	DS	D	35	20	2	52	I	65	34	46	85											Y	amphitheater topography
54	AL	7	1996	6-27	2	DS	D	75	50	4	556	I	50	278	375	80											Y	amphitheater topography
55	AL	7	1996	6-27	4	DS	D	80	20	4	237	N																
56	AL	7	1996	6-27	3	DS	D	80	48	4	569	I	88	501	676													
57	AL	8	1996	7-32	4	DS	D	60	35	4	311	N				73											Y	
58	AL	8	1996	7-32	3	DS	Q	32	16	4	76	N								R								possible road
59	AL	8	1996	6-23	2	DS	Q	48	64	4	455	I	88	400	541													

													Shallow-seated landslides								*Deep-seated landslides*							
ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide Type	Certainty	Size Length	Width	Depth	Slide Vol.	Sed. Routing	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
60	AS	17	1996	7-31	2	DF	D	150	65	10	3611	I	100	3611	4875	52				R							Y	
61	AS	17	1996	7-31	2	DS	D	120	40	3	533	I	100	533	720	75											Y	amphitheater topography
62	AS	17	1996	7-31	2	DS	D	150	45	3	750	I	100	750	1013	85											Y	amphitheater topography
63	AS	17	1987	M16-36	2	DS	D	150	45	5	1250	I	100	1250	1688					R								amphitheater topography
64	AS	17	1996	7-31	4	DS	D	60	30	3	200	N				78											Y	sediment perched in vegetation
65	AS	17	1996	7-31	4	DS	D	40	35	4	207	I	100	207	280	63											Y	
67	AS	17	1996	7-31	2	DS	P	20	16	4	47	I	88	42	56													
68	AS	16	1996	7-31	3	DS	P	48	32	4	228	N																
69	AS	17	1996	7-31	4	DS	P	48	32	4	228	I	88	200	270													cable yard tract
70	AM	17	1996	7-32	4	DS	D	48	20	5.5	196	I	88	172	232					R								possible culvert
71	AM	17	1996	7-32	4	DS	D	48	32	4	228	I	88	200	270													
72	AM	8	1996	7-32	4	DS	D	50	25	5	231	N				75											Y	
74	AM	8	1996	7-32	4	DF	D	125	60	8	2222	I	80	1778	2400	73											Y	20% perched on slope
75	AM	9	1996	7-32	4	DS	D	48	20	4	142	N																
76	AM	8	1996	7-32	4	DS	P	48	48	4	341	I	88	300	406													amphitheater topography
77	AM	17	1996	7-32	3	DS	P	32	32	4	152	N																
78	AL	15	1996	3-12	4	DS	Q-P	32	16	4	76	N																
79	AL	15	1996	3-12	4	DS	Q-P	16	16	4	38	N																
80	AL	15	1996	3-12	4	DS	D	12	48	10	213	I	30	64	86	78				R							Y	ground water observed
81	AL	24	1996	5-18	3	DS	P-D	32	48	4	228	P	88	200	270													
82	AL	23	1996	4-13	3	DS	D	40	35	4	207	I	100	207	280	54			I								Y	
83	AL	23	1996	4-13	3	DS	D	32	16	4	76	I	88	67	90													
84	AL	14	1996	3-12	1	DS	D	64	32	4	303	P	100	303	410													
85	AL	23	1987	M13B-13	3	DS	P	80	32	4	379	I	88	334	451													
87	AL	23	2000	5A-13	NA	RS	D	500	500			N									3	3	4	3	4	N		
88	AL	23	2000	5A-13	NA	RS	P	300	300			N									2	3	4	3	4	N		
89	AL	13	1996	5-19	4	DS	P	48	32	4	228	I	88	200	270													
90	AL	14	1996	4-15	4	DS	Q	16	16	4	38	N																
91	AL	15	1996	3-12	3	DS	D	64	20	4	190	I	88	167	225													
92	AL	13	1996	5-19	2	DS	P	20	48	4	142	I	88	125	169													
93	AM	8	1996	7-33	4	DS	P	64	20	4	190	I	88	167	225													
94	AM	5	1996	7-34	4	DS	D	160	64	4	1517	I	88	1335	1802					R								main stem maybe road, then road
95	AM	5	1996	7-34	4	DF	D	624	16	5.5	2034	I	88	1790	2416					R								624 foot torrent track
96	AM	4	1996	7-34	3	DS	Q-P	48	32	4	228	N																
97	AM	4	1996	7-34	2	DS	Q	48	32	4	228	I	88	200	270													
98	AM	4	1996	7-33	4	DS	D	64	48	4	455	I	88	400	541													
99	AM	4	1996	7-33	3	DF	D	96	20	4	284	I	88	250	338													
100	AM	5	1996	7-33	4	DS	P	80	48	3	427	N				72											Y	scarp only measurable
101	AM	8	1996	7-33	3	DS	D	64	32	4	303	N																
102	AM	8	1996	7-33	3	DS	D	32	32	4	152	N																
103	AM	4	2000	8B-36	NA	RS	P	250	350			I									3	3	4	3	4	N		
104	AM	4	1996	8-40	3	DF	Q	144	160	4	3413	I	88	3004	4055													
105	AM	4	1996	8-40	4	DS	P	64	32	5.5	417	N								R								
106	AM	10	1996	8-39	4	DS	D	48	48	4	341	I	100	341	461				I									
107	AM	10	1996	8-39	4	DS	D	64	32	4	303	I	100	303	410				I									
108	AM	10	1996	8-39	4	DS	D	64	64	4	607	I	100	607	819				I									
109	AM	10	1996	8-39	3	DS	D	60	20	5	222	I	100	222	300	73			I								Y	
110	AM	10	1996	8-39	3	DS	D	110	45	5	917	I	100	917	1238	70			I								Y	
111	AM	10	1996	8-39	3	DS	D	50	45	4	333	I	100	333	450	75			I								Y	
112	AM	4	1996	8-39	4	DS	D	65	42	8	809	N				68				R							Y	highly vegetated
113	AM	4	1996	8-39	4	DS	D	70	40	5	519	N				65				R							Y	
114	AM	9	1996	8-39	4	DS	D	48	20	4	142	I	88	125	169													
115	AM	9	1996	8-39	3	DS	D	32	48	4	228	I	88	200	270													

ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide Type	Certainty	Size Length	Size Width	Size Depth	Slide Vol.	Sed. Routing	*Shallow-seated landslides* Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	*Deep-seated landslides* Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
116	AM	4	2000	8B-36	NA	RS	P	500	350			I									4	3	4	3	4	N		
119	AM	9	1996	8-39	3	DS	D	48	160	4	1138	N																
120	AM	9	1996	8-39	3	DS	D	48	16	4	114	I	88	100	135													
121	AM	9	1996	8-39	4	DS	D	96	64	4	910	P	88	801	1081													
122	AM	9	1996	8-39	3	DS	D	20	15	2	22	I	100	22	30													gully headwardly eroding
123	AM	9	1996	8-39	3	DS	P	32	16	4	76	I	100	76	102													
124	AM	9	1996	8-39	4	DS	D	32	16	4	76	I	100	76	102													
125	AM	10	1996	8-39	2	DS	P	48	32	4	228	I	100	228	307													under shadow
126	AM	10	1996	8-39	2	DS	P	48	32	4	228	I	88	200	270													under trees
127	AM	9	1996	8-37	3	DS	D	60	35	6	467	I	50	233	315	75											Y	50% perched on hillside
129	AM	16	1996	8-37	4	DS	D	15	25	4	56	I	100	56	75	83				R							Y	
130	AM	9	1996	8-37	3	DS	P	32	32	4	152	N																
131	AM	9	1996	8-37	2	DS	P	32	32	4	152	I	88	133	180													
132	AS	16	1996	8-37	4	DS	D	40	25	1	37	I	80	30	40				I									20% perched on stump
133	AS	16	1996	8-36	4	DF	P	240	32	5.5	1564	I	100	1564	2112					R								
134	AS	16	1996	8-36	2	DS	D	48	32	4	228	I	100	228	307				I									
135	AS	16	1996	8-37	4	DS	D	80	48	5.5	782	I	100	782	1056					R								
136	AS	16	1996	8-37	4	DS	D	64	48	5.5	626	N								R								
137	AS	16	1996	8-37	4	DS	P	48	32	4	228	I	88	200	270													
138	AS	15	1996	8-34	3	DS	P	32	16	4	76	N																
139	AS	15	1996	8-34	3	DF	D	640	32	5.5	4172	I	100	4172	5632					R								
140	AS	15	1996	8-34	3	DS	D	160	32	4	759	I	88	667	901													
141	AS	15	1996	8-34	3	DF	D	704	32	4	3337	I	100	3337	4506													
142	AS	15	1996	8-34	3	DS	D	240	48	4	1707	I	88	1502	2028													
143	AS	15	1996	8-34	3	DS	D	160	32	5.5	1043	I	88	918	1239					R								
144	AS	16	1996	8-36	4	DS	D	64	48	4	455	N																
145	AS	15	1996	8-36	3	DS	P	48	32	4	228	I	88	200	270													
146	AS	15	1996	8-35	3	DS	D	150	65	10	3611	I	100	3611	4875	60				R							Y	shotgun culvert
147	AS	15	1996	8-35	4	DS	D	150	60	4	1333	P	100	1333	1800	78											Y	
148	AS	21	1996	8-35	3	DS	P	32	32	4	152	N																
149	AS	21	1996	8-35	3	DS	P	32	16	4	76	I	88	67	90													
150	AS	21	1996	8-35	3	DS	D	84	45	8	1120	N				77				R							Y	
151	AS	21	1987	M17-38	3	DF	P	64	16	4	152	I	88	133	180													
152	AS	21	1987	M17-38	4	DS	D	75	50	3	417	N				74											Y	
153	AS	21	1996	8-34	3	DS	D	48	16	4	114	N																cable yard tract
154	AS	22	1996	9-33	4	DS	Q	48	32	5.5	313	I	88	275	372					R								
155	AS	15	1996	9-33	3	DF	D	70	85	10	2204	I	100	2204	2975	65				R							Y	initiation slide dimensions
156	AS	15	1996	9-33	4	DS	D	48	32	4	228	N																
157	AS	23	1996	10-31	4	DS	D	48	32	4	228	N																
158	AS	23	1996	10-31	2	DS	D	64	32	4	303	I	88	267	360													
159	AM	10	1996	9-34	4	DS	D	48	48	4	341	N																
160	AM	3	1996	9-36	4	DS	P	48	32	4	228	N																
161	AM	3	1996	9-36	4	DS	D	64	64	5.5	834	N								R								
162	AM	11	1996	10-34	3	DS	P	64	32	4	303	N																
163	AM	11	1996	10-34	4	DS	Q	32	16	4	76	N																
164	AM	3	1996	9-37	3	DS	P	48	20	4	142	I	88	125	169													
165	AM	3	1996	9-37	2	DS	D	80	32	4	379	I	88	334	451													
166	AU	2	1987	M19-47	4	DS	Q	64	48	4	455	P	88	400	541													
167	AM	13	1996	10-33	4	DS	P	64	32	4	303	N																
168	AM	14	1996	10-33	2	DS	P	80	32	4	379	I	88	334	451													
169	AS	23	1996	10-31	3	DS	D	80	25	2	148	I	100	148	200	65											Y	
170	AS	23	1996	10-31	4	DF	D	250	50	6	2778	I	100	2778	3750	67				R							Y	long flow
171	AS	23	2000	10B-30	NA	RS	D	500	500			I									3	2	3	3	4	N		

													Shallow-seated landslides								*Deep-seated landslides*							
ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide Type	Certainty	Size			Slide Vol.	Sed. Routing	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
								Length	Width	Depth																		
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
172	AS	26	1996	10-30	2	DS	P	64	32	4	303	I	88	267	360													
173	AL	23	1987	M13B-13	2	DS	D	60	35	6	467	I	100	467	630				I									
174	AL	23	1987	M13B-13	3	DS	D	16	16	4	38	I	88	33	45													
175	AL	23	1987	7 / M13B-	3	DS	D	128	32	4	607	I	88	534	721													
176	AL	23	1987	M13B-13	3	DS	D	48	16	5.5	156	N								R								
177	AL	25	2000	5A-11	NA	RS	D	1300	500			P									3	3	3	3	4	N		
178	AL	25	1987	M14B-17	2	DS	D	80	32	4	379	I	88	334	451													
179	AL	24	1987	M14B-17	4	DF	D	560	40	4	3319	P	100	3319	4480													
180	AL	25	1987	M15-35	3	DS	P	112	48	4	796	I	88	701	946													
181	AL	19	1987	M15-36	3	DS	P	112	48	4	796	I	88	701	946													
182	AL	18	1987	M15-37	3	DS	P	48	20	4	142	N																
183	AL	7	1987	M15-37	4	DS	P	112	32	4	531	I	100	531	717													
184	AS	21	1987	M16-36	2	DS	D	80	20	5	296	I	88	261	352	78				R							Y	scarp rocked, depth apparent
185	AS	21	1987	M16-36	3	DS	P	48	20	4	142	N																
186	AS	17	1987	M16-36	4	DF	D	240	32	5.5	1564	N								R								
187	AS	17	1987	M16-36	3	DS	Q	48	32	4	228	N																
188	AS	17	1987	M16-36	4	DS	P	48	32	4	228	N																
189	AL	8	1987	M16-37	3	DF	D	240	32	4	1138	I	88	1001	1352													
190	AL	7	1987	M16-37	4	DS	D	50	42	4	311	N				75											Y	deposit perched on hillside
191	AS	22	1987	M17-38	4	DS	D	150	50	4	1111	P	100	1111	1500	85				R							Y	
192	AS	22	1987	M17-38	4	DS	D	85	40	8	1007	P	100	1007	1360	88				R							Y	
195	AS	16	1987	M17-39	2	DS	D	45	20	3	100	I	100	100	135													revegetating heavily
196	AS	15	1987	M17-39	4	DS	D	160	32	5.5	1043	I	100	1043	1408					R								
197	AS	15	1987	M17-39	3	DF	Q	320	32	5.5	2086	I	88	1836	2478					R								
198	AM	9	1987	M17-40	4	DS	D	125	50	4	926	I	100	926	1250					R								
199	AM	9	1987	M17-40	4	DS	P	48	16	4	114	N																
200	AS	14	1987	M18-41	4	DS	Q	80	32	4	379	I	88	334	451					R								could be a road
201	AM	9	1987	M17-41	4	DS	P	128	16	3	228	I	88	200	270	85				R							Y	
203	AS	22	1987	M18-39	4	DS	Q	64	48	4	455	N																
204	AS	14	2000	field obs	4	DS	D	220	78	5	3178	I	100	3178	4290	65				R							Y	ground water high
205	AU	2	1987	M19-47	3	DF	P	60	32	4	284	I	100	284	384													path covered by trees (min d)
206	AU	8	1987	M21-45	4	DS	P	240	48	5.5	2347	I	88	2065	2788					R								
207	AU	5	1987	M21-46	4	DF	P	128	20	4	379	N																
208	AL	23	2000	4A-11	NA	RS	D	700	700			P									4	4	5	4	4	N		
209	AL	15	2000	4A-11	NA	RS	D	600	600			P									4	3	4	3	4	N		
210	AL	15	2000	4A-11	NA	RS	Q	200	100			I									3	3	5	4	4	N		
215	AL	22	1996	3-12	4	DS	D	40	30	8	356	N				74				R							Y	shotgun culvert
216	AL	30	2000	field obs	4	DS	D	60	45	5	500	I	100	500	675	95				R							Y	
217	AM	4	1996	8-40	3	DS	D	160	96	4	2276	I	75	1707	2304	68				R							Y	
218	AM	4	2000	field obs	4	DS	D	180	60	4	1600	I	75	1200	1620	75											Y	
219	AS	14	1996	10-33	4	DS	D	90	60	4	800	I	75	600	810	78				R								
220	AS	14	2000	10B-30	NA	RS	D	500	300			P									4	3	4	4	4	N		
221	AS	14	2000	field obs	4	DS	D	150	40	5	1111	I	85	944	1275	60											Y	toe of DSL
222	AL	7	1996	6-27	1	DS	D	60	42	12	1120	P	85	952	1285	102				R							Y	
223	AL	7	1996	6-27	2	DS	D	40	75	3	333	N				95											Y	deposit perched on terrace
224	AL	7	1996	6-27	1	DS	D	40	42	4	249	N				75											Y	
225	AM	8	2000	field obs	4	DS	D	70	160	5	2074	I	100	2074	2800	82				R							Y	escola slide
226	AM	8	2000	field obs	4	DS	D	70	24	5	311	I	100	311	420	85				R							Y	escola slide
227	AL	15	1996	3-12	4	DS	D	50	10	3	56	I	100	56	75	80											Y	fern overgrowth
228	AL	15	1996	3-12	4	DS	D	60	10	2	44	I	10	4	6	80											Y	water can be seen, intermittent
229	AL	15	1987	M12-10	5	DS	D	50	85	3	472	N				85				R							Y	
230	AL	15	1996	3-12	4	DS	D	65	40	3	289	N				78				R							Y	
231	AS	17	1987	M16-36	2	DS	D	30	40	2	89	I	100	89	120	90			I								Y	

								Size					Shallow-seated landslides								Deep-seated landslides							
ID# Unique	PWS	Sec #	Air Photo year	Air Photo frame	MWMU	Landslide Type DS DF DT EF RS	Certainty D P Q	Length feet	Width feet	Depth feet	Slide Vol. yd^3	Sed. Routing P I N	Sed. Del. Ratio 25 50 75 100 (%)	Sed. Delivery yd^3	Sed. Delivery tons	Slope (field) (%)	Age A R O	Slope Form C D P	Slide Loc. H S I N	Road Assoc. R S L N I	Toe Activity 1 2 3 4 5	Body Morph. 1 2 3 4 5	Lat. Scarps 1 2 3 4 5	Main Scarps 1 2 3 4 5	DS Veg. 1 2 3 4	Complex Y N	Field Obs. Y N	Comments
232	AS	21	2000	field obs	1	DS	D	100	36	4	533	P	100	533	720	82			I	R							Y	
233	AS	21	2000	field obs	1	DS	D	100	42	4	622	P	100	622	840	78			I	R							Y	
238	AS	21	1996	8-35	3	DS	D	85	40	4	504	N				80				R							Y	
239	AS	21	1996	8-35	2	DF	D	150	40	6	1333	I	100	1333	1800	94				R							Y	
240	AS	21	2000	field obs	3	DF	D	45	30	5	250	I	100	250	338	81											Y	initiation slide dimensions
241	AS	21	2000	field obs	3	DS	D	85	30	5	472	I	100	472	638	80				R							Y	
242	AS	21	2000	field obs	4	DS	D	120	60	8	2133	I	100	2133	2880	78											Y	dense slash on slope
243	AS	21	2000	field obs	4	DS	D	85	40	4	504	I	100	504	680	80				R							Y	
244	AS	21	2000	field obs	4	DS	D	95	30	4	422	I	100	422	570	75											Y	
245	AS	21	1996	8-35	4	DS	D	40	25	3	111	N				85				R							Y	
246	AS	16	2000	field obs	2	DF	D	120	40	6	1067	I	85	907	1224	56											Y	root strength not a factor
247	AS	15	1996	9-33	3	DS	D	40	40	3	178	I	50	89	120	102				R							Y	50% perched on road
248	AS	15	1996	9-33	2	DS	D	50	85	2	315	I	50	157	213	92				R							Y	50% perched on road, dozed away
249	AS	15	1996	9-33	4	DS	D	200	40	4	1185	I	100	1185	1600	65				R							Y	below road, may be associated
250	AM	10	1987	M18-42	4	DS	D	140	65	6	2022	I	87	1759	2375													delivery = estimated scarp volume
251	AM	10	2000	field obs	4	DS	D	120	45	8	1600	I	100	1600	2160	65				R							Y	
252	AM	10	2000	field obs	4	DS	D	45	36	4	240	I	25	60	81	62				R							Y	75% perched on road
253	AM	10	1987	M18-42	4	DS	D	80	40	5	593	I	100	593	800	80				R							Y	fern overgrowth
254	AM	10	2000	field obs	4	DS	D	80	45	5	667	I	90	600	810	46				R							Y	initiation slide
255	AS	16	2000	field obs	4	DF	D	120	60	10	2667	P	100	2667	3600	70				R							Y	across mainline road to Albion
256	AS	16	2000	field obs	4	DS	D	80	55	5	815	I	50	407	550	53				R							Y	50% perched on road
257	AS	21	2000	field obs	1	DS	D	45	30	4	200	I	100	200	270	73			I	R							Y	
258	AS	21	1996	8-35	1	DS	D	40	25	4	148	I	100	148	200	75			I	R							Y	
259	AM	9	2000	field obs	3	DS	D	95	40	5	704	I	100	704	950	85			I								Y	
260	AS	17	1996	7-31	1	DS	D	60	35	3	233	P	100	233	315	85			I								Y	
261	AS	17	1996	7-31	1	DS	D	35	15	2	39	P	100	39	53	88			I								Y	
262	AS	15	1996	9-33	3	DS	D	200	65	10	4815	I	100	4815	6500	73				L							Y	off side of landing
263	AS	26	2000	field obs	4	DS	D	55	20	4	163	N				73				R							Y	more to go at this spot (60 foot crack)
264	AL	14	2000	field obs	4	DS	D	120	80	4	1422	P	100	1422	1920	80				R							Y	
265	AL	14	1996	4-14	4	DS	D	120	80	4	1422	P	50	711	960	84				R							Y	
266	AL	14	2000	field obs	4	DS	D	70	40	3	311	P	70	218	294	79				R							Y	
267	AL	14	1996	4-14	4	DS	D	62	38	4	349	P	50	175	236	84				R							Y	
269	AM	3	2000	9B-35	NA	RS	D	600	600			I									3	2	4	3	4	N	Y	
270	AM	11	2000	9B-35	NA	RS	D	1300	3500			P									3	2	4	2	4	Y	Y	complex of eight mappable rockslides
271	AM	10	2000	field obs	4	DS	D	100	65	9	2167	I	25	542	731	65				R							Y	
272	AM	10	1996	9-36	4	DS	D	70	60	3	467	I	30	140	189	50				R							Y	
273	AL	30	2000	6-17	NA	RS	P	550	450			P									2	2	3	3	4	N		
274	AL	18	1996	6-25	4	DF	D	68	32	4	322	I	100	322	435													
275	AS	17	2000	field obs	2	DS	D	45	90	4	600	P	100	600	810	85			I								Y	
276	AS	21	2000	field obs	1	DS	D	45	2	4	13	P	100	13	18	95			I								Y	outside meander
277	AS	21	2000	field obs	1	DS	D	40	60	3	267	P	100	267	360	95			I								Y	outside meander
278	AS	21	1996	8-35	1	DS	D	20	15	4	44	P	100	44	60	95			I								Y	
279	AS	21	1996	8-35	1	DS	D	20	40	5	148	P	100	148	200	85				S							Y	
280	AS	16	2000	field obs	1	DS	D	20	15	2	22	P	100	22	30	75			I								Y	
155a	AS	15	1996	9-33	3	DT	D	200	10	5	370	I	100	370	500													runout dimensions
240a	AS	21	2000	field obs	3	DT	D	200	5	5	185	I	100	185	250													runout dimensions
254a	AM	10	2000	field obs	4	DS	D	70	65	12	2022	I	100	2022	2730	80				R							Y	
274a	AL	18	1996	6-25	4	DT	D	80	16	4	190	I	100	190	256													
300	AR	8	2000	2-3	NA	RS	P	300	240			P									4	4	5	3	4	N		
301	AR	8	2000	2-3	NA	RS	P	520	780			P									4	3	4	3	4	Y		adjacent to #4
302	AR	16	2000	2-3	NA	RS	P	380	420			P									3	3	3	2	4	N		
303	AL	15	2000	2-3	NA	RS	D	450	200			P									4	4	5	4	4	N		
304	AL	15	2000	2-3	NA	RS	Q	500	300			P									3	2	3	3	4	N		

ID# Unique	PWS	Sec #	Air Photo year	Air Photo frame	MWMU	Landslide Type DS DF DT EF RS	Certainty D P Q	Size Length feet	Size Width feet	Size Depth feet	Slide Vol. yd^3	Sed. Routing P I N	*Shallow-seated landslides* Sed. Del. Ratio 25 50 75 100 (%)	Sed. Delivery yd^3	Sed. Delivery tons	Slope (field) (%)	Age A R O	Slope Form C D P	Slide Loc. H S I N	Road Assoc. R S L N I	*Deep-seated landslides* Toe Activity 1 2 3 4 5	Body Morph. 1 2 3 4 5	Lat. Scarps 1 2 3 4 5	Main Scarps 1 2 3 4 5	DS Veg. 1 2 3 4	Complex Y N	Field Obs. Y N	Comments
305	AL	22	2000	2-3	4	DS	D	100	50	5.5	1019	N					R	P	N	R								
306	AL	15	2000	4A-11	NA	RS	Q	400	200			I									3	3	5	4	4	N		
307	AL	23	2000	4A-11	NA	RS	Q	800	300			P									4	3	3	3	4	N		
308	AL	14	2000	field obs	2	DS	D	60	20	4	178	I	100	178	240	70	A	P	I	N							Y	Discovered during THP process
309	AL	14	2000	field obs	4	DS	D	80	15	4	178	I	25	44	60	70	A	P	I	N							Y	Discovered during THP process
310	AL	14	2000	4A-11	4	DS	P	40	25	5.5	204	N					A	D	N	R								
311	AL	14	2000	4A-13	NA	RS	P	700	350			P									3	3	4	3	4	N		
313	AL	25	2000	5A-11	NA	RS	P	500	350			I									4	2	3	2	4	N		
314	AL	25	2000	5A-11	NA	RS	P	450	400			P									3	2	3	3	4	N		
315	AL	25	2000	5A-11	NA	RS	Q	400	500			P									3	4	5	4	4	N		
316	AL	25	2000	5A-11	NA	RS	P	350	350			P									3	3	5	4	4	N		
317	AL	24	2000	5A-11	3	DS	D	25	20	4	74	N					A	C	H	N								
318	AL	23	2000	5A-13	NA	RS	P	350	300			P									3	3	4	3	4	N		
319	AL	24	2000	5A-13	NA	RS	P	400	350			P									3	3	4	4	4	N		
320	AL	24	2000	5A-13	NA	RS	Q	500	300			P									4	3	3	3	4	N		
321	AL	24	2000	5A-13	NA	RS	P	700	600			P									4	3	4	3	4	N		
322	AL	13	2000	5A-13	NA	RS	Q	500	500			P									3	3	5	4	4	N		
323	AL	13	2000	5A-13	NA	RS	P	200	150			I									2	4	4	4	4	N		
324	AL	13	2000	5A-13	NA	RS	P	400	250			I									3	3	4	3	4	N		
325	AL	18	2000	5A-13	NA	RS	Q	500	250			I									3	4	4	4	4	N		
326	AL	18	2000	5A-13	NA	RS	Q	150	150			I									3	3	4	4	4	N		
327	AL	24	2000	5A-13	3	DS	D	50	25	4	185	I	100	185	250		R	C	H	N								
328	AL	18	2000	5A-13	4	DS	D	40	20	4	119	N					R	P	N	N								
329	AL	13	2000	5A-15	NA	RS	Q	450	250			P									4	3	4	3	4	N		
330	AL	12	2000	5A-15	NA	RS	P	700	600			P									3	3	4	3	4	N		
331	AL	13	2000	5A-15	NA	RS	Q	350	300			P									3	4	4	4	4	N		
332	AL	13	2000	5A-15	3	DS	D	40	40	5.5	326	N					A	P	N	R								
333	AL	13	2000	5A-15	3	DS	D	60	50	5.5	611	N					A	P	N	R								
334	AL	18	2000	5A-15	3	DT	D	80	60	5.5	978	I	100	978	1320		A	C	H	R								400 foot torrent track
335	AL	30	2000	6-17	NA	RS	Q	300	450			P									4	3	4	3	4	N		
336	AL	25	2000	6-17	NA	RS	Q	200	150			I									4	4	4	4	4	N		
338	AL	30	2000	6-17	NA	RS	P	150	200			P									3	3	4	3	4	N		
339	AL	19	2000	6-17	NA	RS	P	200	200			I									3	3	4	4	4	N		
340	AL	30	2000	6-17	4	DS	D	60	45	5.5	550	I	100	550	743		A	C	H	R								
341	AL	19	2000	6-17	4	DT	D	60	20	5.5	244	I	100	244	330		A	C	H	R								260 foot torrent track
343	AL	18	2000	6-19	NA	RS	Q	300	300			P									4	4	4	4	4	N		
344	AL	18	2000	6-19	NA	RS	Q	400	300			P									4	3	3	4	4	N		
345	AL	18	2000	6-19	NA	RS	P	400	450			P									2	2	4	3	4	N		
346	AL	18	2000	6-19	4	DT	D	100	80	5.5	1630	I	100	1630	2200		A	C	H	L								700 foot torrent track
347	AL	18	2000	6-19	3	DT	D	50	25	4	185	I	100	185	250		R	C	H	N								
348	AS	17	2000	6-19	NA	RS	P	300	200			I									3	3	4	3	4	N		
349	AS	17	2000	6-19	NA	RS	D	1000	450			P									3	3	4	3	4	N		
350	AS	17	2000	6-19	NA	RS	D	150	150			I									3	3	3	3	4	N		
351	AS	17	2000	6-19	NA	RS	D	250	200			P									3	3	3	3	4	N		
352	AL	7	2000	6-21	NA	RS	P	2000	1500			P									3	3	4	4	4	N		
353	AL	7	2000	6-21	NA	RS	P	900	1100			P									4	3	4	4	4	N		
354	AL	7	2000	6-21	NA	RS	P	750	850			P									3	3	4	3	4	N		
355	AL	7	2000	6-21	NA	RS	Q	600	650			P									3	4	4	3	4	N		
356	AL	7	2000	6-21	NA	RS	Q	600	400			P									3	3	3	2	4	N		
357	AS	17	2000	7B-28	NA	RS	P	750	350			P									4	4	3	4	4	N		
358	AS	17	2000	7B-28	NA	RS	P	700	350			P									3	3	4	3	4	N		
359	AS	20	2000	7B-28	NA	RS	P	1700	900			P									4	3	5	3	4	N		
360	AS	20	2000	7B-28	NA	RS	Q	700	200			I									4	4	4	4	4	N		

													Shallow-seated landslides								Deep-seated landslides							
ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide Type	Certainty	Size Length	Width	Depth	Slide Vol.	Sed. Routing	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
361	AS	21	2000	7B-28	NA	RS	Q	450	300			I									3	3	4	3	4	N		
362	AS	21	2000	7B-28	NA	RS	D	550	500			I									3	3	3	2	4	N		
363	AS	21	2000	7B-28	NA	RS	D	1200	1100			P									4	3	3	2	4	N		
364	AS	21	2000	7B-28	NA	RS	D	350	300			P									3	3	3	2	4	N		
365	AS	17	2000	7B-30	NA	RS	Q	1500	750			P									4	3	4	3	4	N		
366	AS	16	2000	7B-30	NA	RS	Q	850	700			I									4	4	4	4	4	N		
367	AM	8	2000	7B-30	NA	RS	P	1100	1000			P									3	4	4	4	4	N		
368	AM	8	2000	7B-30	NA	RS	Q	600	700			P									3	4	3	3	4	N		
369	AM	8	2000	7B-30	NA	RS	Q	400	600			P									4	4	4	4	4	N		
370	AM	8	2000	7B-30	NA	RS	Q	450	250			P									4	4	4	4	4	N		
371	AM	9	2000	7B-30	NA	RS	P	900	400			P									4	3	4	4	4	Y		Nested with #372
372	AM	9	2000	7B-30	NA	RS	P	400	500			I									4	3	4	3	4	Y		Nested with #371
373	AM	9	2000	7B-30	NA	RS	P	600	400			P									3	3	4	3	4	Y		Nested with #374
374	AM	9	2000	7B-30	NA	RS	P	700	400			N									4	4	4	4	4	Y		Nested with #373
375	AM	9	2000	7B-30	3	DS	D	50	25	4	185	I	100	185	250		R	C	H	N								
376	AM	8	2000	7B-32	NA	RS	Q	1100	1100			P									4	2	4	3	4	N		
377	AM	5	2000	7B-32	NA	RS	P	250	200			I									4	3	4	3	4	N		
378	AM	5	2000	7B-32	NA	RS	P	200	400			I									4	3	4	3	4	N		
379	AM	4	2000	7B-32	NA	RS	Q	400	350			I									4	3	4	3	4	N		
380	AM	4	2000	7B-32	NA	RS	Q	250	250			I									4	4	4	4	4	N		
381	AS	27	2000	8B-30	NA	RS	D	500	300			I									2	3	3	2	4	N		
382	AS	27	2000	8B-30	NA	RS	D	800	500			P									3	3	3	2	4	N		
383	AS	27	2000	8B-30	4	DS	D	50	30	5.5	306	I	100	306	413		A	C	H	R								
384	AS	21	2000	8B-32	NA	RS	D	2000	2100			P									3	2	4	3	4	Y		complex of five mappable rockslides
386	AS	22	2000	8B-32	NA	RS	P	600	900			P									3	3	4	3	4	N		
387	AS	21	2000	8B-32	NA	RS	P	400	350			N									4	3	3	4	4	N		
388	AS	21	2000	8B-32	NA	RS	P	600	400			N									4	3	4	3	4	N		
389	AS	16	2000	8B-32	NA	RS	P	1000	1000			P									3	3	3	4	4	N		
390	AS	21	2000	8B-32	3	DT	D	25	25	4	93	I	100	93	125		R	C	S	N								150 foot torrent track
391	AS	16	2000	8B-34	NA	RS	Q	200	150			P									3	4	4	4	4	N		
392	AS	15	2000	8B-34	NA	RS	Q	600	450			I									4	4	4	3	4	Y		Nested with #394
393	AS	15	2000	8B-34	NA	RS	P	350	200			I									3	3	4	4	4	N		
394	AS	15	2000	8B-34	NA	RS	P	500	250			I									4	3	4	3	4	Y		Nested with #392
395	AS	16	2000	8B-34	NA	RS	Q	600	450			I									3	3	3	4	4	N		
396	AS	16	2000	8B-34	NA	RS	Q	500	400			P									4	4	4	4	4	N		
397	AS	16	2000	8B-34	NA	RS	P	700	350			I									3	3	4	3	4	N		
398	AS	16	2000	8B-34	NA	RS	P	400	250			I									4	3	4	3	4	N		
399	AM	10	2000	8B-34	NA	RS	D	2000	1400			P									4	2	3	4	4	N		
400	AM	10	2000	8B-34	NA	RS	Q	1000	400			I									4	2	4	3	4	N		
401	AM	9	2000	8B-34	NA	RS	Q	450	300			P									4	3	3	4	4	N		
402	AM	9	2000	8B-34	NA	RS	P	350	300			P									3	3	3	3	4	N		
403	AM	16	2000	8B-34	2	DS	D	40	20	4	119	I	100	119	160		R	P	S	N								
404	AM	4	2000	8B-36	NA	RS	P	500	250			I									4	3	4	3	4	N		
405	AM	4	2000	8B-36	NA	RS	Q	250	250			I									4	4	4	4	4	N		
406	AM	4	2000	8B-36	NA	RS	Q	200	150			I									4	3	4	4	4	N		
407	AM	4	2000	8B-36	NA	RS	P	300	300			I									4	4	4	4	4	N		
408	AM	4	2000	8B-36	4	DS	D	25	15	4	56	N					R	C	N	N								
409	AM	10	2000	8B-36	4	DS	D	50	50	4	370	I	100	370	500		R	C	H	N								
410	AS	22	2000	9B-31	4	DS	D	50	25	5.5	255	I	100	255	344		A	C	H	L								
411	AS	22	2000	9B-31	NA	RS	P	600	350			I									3	3	4	3	4	N		
412	AS	22	2000	9B-31	NA	RS	D	400	150			N									3	3	3	3	4	N		
413	AS	15	2000	9B-31	4	DT	D	50	25	4	185	I	100	185	250		R	C	H	N								150 foot torrent track
414	AS	15	2000	9B-31	2	DT	D	20	10	5.5	41	I	100	41	55		A	C	H	R								100 foot torrent track

													Shallow-seated landslides								Deep-seated landslides							
ID#	PWS	Sec	Air Photo	Air Photo	MWMU	Landslide Type	Certainty	Size			Slide Vol.	Sed. Routing	Sed. Del. Ratio	Sed. Delivery	Sed. Delivery	Slope (field)	Age	Slope Form	Slide Loc.	Road Assoc.	Toe Activity	Body Morph.	Lat. Scarps	Main Scarps	DS Veg.	Complex	Field Obs.	Comments
								Length	Width	Depth																		
Unique		#	year	frame		DS DF DT EF RS	D P Q	feet	feet	feet	yd^3	P I N	25 50 75 100 (%)	yd^3	tons	(%)	A R O	C D P	H S I N	R S L N I	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4	Y N	Y N	
415	AS	14	2000	9B-33	NA	RS	P	350	150			P									3	3	4	3	4	N		
416	AS	14	2000	9B-33	NA	RS	P	100	100			N									3	3	4	3	4	N		
417	AS	14	2000	9B-33	NA	RS	P	300	200			P									3	3	4	4	4	N		
418	AS	14	2000	9B-33	NA	RS	Q	300	200			N									4	3	4	4	4	N		
419	AM	10	2000	9B-33	NA	RS	D	600	350			I									3	3	4	3	4	N		
420	AM	10	2000	9B-33	NA	RS	P	300	200			I									4	4	4	3	4	N		
421	AM	10	2000	9B-33	NA	RS	D	600	300			I									3	3	4	4	4	N		
422	AM	10	2000	9B-33	NA	RS	D	150	100			I									3	4	4	4	4	N		
423	AM	11	2000	9B-33	NA	RS	P	400	250			P									3	3	4	4	4	Y		Nested with #424
424	AM	11	2000	9B-33	NA	RS	D	300	250			P									3	3	4	3	4	Y		Nested with #423
425	AM	11	2000	9B-33	2	DS	D	50	25	4	185	P	100	185	250		R	P	S	N								
426	AM	11	2000	9B-33	NA	RS	P	1000	400			P									4	3	3	3	4	N		
427	AM	10	2000	9B-35	NA	RS	D	400	400			P									3	3	4	3	4	N		
428	AM	10	2000	9B-35	NA	RS	P	150	250			I									3	2	2	2	3	N		
429	AM	3	2000	9B-35	NA	RS	P	900	400			N									4	3	3	3	4	N		
430	AM	3	2000	9B-35	NA	RS	P	300	300			I									2	3	3	3	4	N		
431	AM	3	2000	9B-35	NA	RS	D	200	200			I									3	3	4	3	4	N		
432	AM	3	2000	9B-35	NA	RS	P	1000	800			I									2	2	3	4	4	N		
433	AU	2	2000	9B-35	NA	RS	D	500	600			P									3	3	3	3	4	N		
434	AU	2	2000	9B-35	3	DS	P	50	25	4	185	N					R	P	N	N								
435	AS	23	2000	10B-30	NA	RS	Q	400	350			I									3	3	2	3	4	N		
436	AS	23	2000	10B-30	NA	RS	Q	750	1100			I									4	4	4	4	4	N		
437	AS	23	2000	10B-30	NA	RS	P	400	250			I									3	4	4	3	4	N		
438	AS	23	2000	10B-30	4	DS	D	20	20	5.5	81	N					R	P	N	R								
439	AS	13	2000	10B-30	NA	RS	P	250	300			I									4	3	4	3	4	N		
440	AS	13	2000	10B-30	NA	RS	Q	1200	500			P									4	4	4	4	4	N		
441	AS	14	2000	field obs	3	DF	D	20	25	4	74	P	25	19	25	65	A	C	H	N							Y	400 foot torrent track
442	AM	11	2000	10B-33	NA	RS	Q	1100	400			P									3	3	4	4	4	N		
443	AM	11	2000	10B-33	NA	RS	P	500	400			P									4	3	3	4	4	N		
444	AM	11	2000	10B-33	NA	RS	Q	150	200			I									3	3	3	4	4	N		
445	AM	11	2000	10B-33	NA	RS	Q	600	400			P									3	3	3	3	4	N		
446	AM	11	2000	10B-33	NA	RS	P	600	300			P									3	3	4	3	4	N		
447	AU	2	2000	10B-35	NA	RS	Q	400	300			P									4	4	4	4	4	N		
448	AU	31	2000	11C-7	NA	RS	P	350	500			P									3	3	4	4	4	N		
449	AU	8	2000	12C-30	NA	RS	P	800	1100			P									4	3	4	3	4	N		
450	AU	8	2000	12C-30	NA	RS	P	1400	400			P									4	3	4	2	4	N		
451	AU	5	2000	12C-32	NA	RS	D	900	500			N									4	3	4	2	4	N		