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# TECHNICAL MEMORANDUM

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| TO: | White Pass MDP FEIS Project File |
| FROM: | Alex White |
| CC: | SE GROUP Project Files |
| DATE: | November 12, 2004 |
| RE: | White Pass MDP FEIS<br>Geology and Mass Wasting |

This memorandum addresses the geology of the White Pass MDP project area and mass wasting associated with the implementation of the alternatives evaluated in the White Pass MDP FEIS.[1] Mass wasting was not identified as a significant issue for tracking in the FEIS, nor did mass wasting drive the development of any alternative. This analysis was developed to identify the potential to accelerate mass wasting with the construction of ski area facilities under the alternatives evaluated in the FEIS.

## 1.0 AFFECTED ENVIRONMENT

The geology of the White Pass Study Area consists of an uplifted block of the sedimentary Russell Ranch Formation that was formed during the Jurassic-Cretaceous period. The Russell Ranch Formation is highly faulted and sheared, low-grade metamorphic, graywacke and argillite with minor interbeds of conglomerate and carbonaceous siltstone (Clayton 1983). The Russell Ranch Formation has been interpreted to be part of a dismembered sea floor assemblage (Swanson 1978). The Russell Ranch Formation is dominantly overlain by various Pleistocene volcanics. The Pleistocene volcanics, mostly lava flows, erupted from several small vents and are variable in composition, ranging from dacite and andesite to basalt (Clayton 1983). Volcanic vents within the White Pass Study Area are at Hogback Mountain and Deer Lake Mountain. Other nearby volcanoes include Round Mountain, Spiral Butte, and Tumac Mountain.

[1] By definition, geology is the science and study of the solid matter of the earth, its composition, structure, physical properties, history and the processes that shape it. The term "geology" is used in this FEIS to describe the rock types occurring in the White Pass Study Area.
Mass wasting, also known as mass movement or slope movement, is the geomorphic process by which soil, regolith, and rock move downslope under the force of gravity. Types of mass wasting include creep, slides, flows, topples, and falls, each with their own characteristic features, and take place over timescales from seconds to years. When the gravitational force acting on a slope exceeds its resisting force, slope failure (mass wasting) occurs.

Three distinct geomorphic land types have been created to describe underlying geologic materials, mass wasting potential, and terrain analysis based on methods from Brazil and Wooten (1985). Mass Wasting is a relatively rapid down slope movement of rock and soil, including slumps, slides, rock falls, avalanches, and debris flows. These are natural disturbance mechanisms, which can frequently occur in steep, mountainous landscapes. These geomorphic land types and their features as related to slope stability and groundwater are discussed below and their locations shown in Figure 3-2 of the FEIS.

Landtype A is characterized by gentle plateau-like northeast to northwest facing slopes between Hogback Ridge and the Ginnette lakes to the northeast. Elevations range from 6,789 feet at Hogback Mountain to 5,420 feet at the northern limit of the unit. Underlain by relatively young resistant basalt, the soil in the area is generally poorly drained, with many ephemeral streams but few well-defined drainage networks. Areas of internally drained topography combined with shallow soil result in numerous small wetlands and there are also several small ponds within Landtype A. Most of Pigtail and Hogback Basins are in Landtype A and are not very susceptible to mass wasting.

Landtype B is characterized by moderate to steep slopes that either surround or are on the edges of the plateau-like slopes of Landtype A. Similar to Landtype A in that it is underlain by basalt, Landtype B is also frequently associated with Talus and Landslide Landtypes within the White Pass Study Area. Mass wasting events occur frequently in this unit on north to west-facing slopes because of the steep slopes associated with this Landtype. Rock fall and rock slides are the most common mass wasting types occurring in this Landtype. Slopes most susceptible to mass wasting in the area are steep slopes greater than 60 percent slope in Landtype B and/or areas with concentrated surface runoff or springs.

Landtype C consists mainly of colluvial and residual soil from highly fractured, deeply-weathered sandstone, siltstone and greywacke. Landtype C is found on gentle to moderate slopes in the northernmost part of the White Pass Study Area below 4,800 feet. Mass wasting is also common in the upper elevations of this Landtype. Ground water seeps and springs are most common in north-facing slopes in Landtype C at the contact of Landtypes B and C. Permeable north-dipping, scoriaceous or breccia zones between basalt layers in Landtype B transmit groundwater in a northerly direction. In Landtype C, drainages are more developed and incised because of less resistant rock.

Areas of large, recent mass wasting events were also mapped within and adjacent to the White Pass Study Area and termed the Landslide Landtype (refer to Figure 3-2 of the FEIS). The Landslide Landtype occurs primarily on steep slopes within Landtypes B and C in the western portions of the White Pass Study Area.

The Talus Landtype is the least abundant Landtype within the White Pass Study Area. Talus is characterized by rock and boulder fields on steep slopes that are frequently associated with cliffs and rock fall. Seeps and groundwater-fed wetlands can be found at the base of some talus fields within the White Pass Study Area (refer to Figure 3-2 of the FEIS).

# 2.0 ENVIRONMENTAL CONSEQUENCES

## 2.1 ALTERNATIVE 1

Under the No Action Alternative, there are no proposed activities in the White Pass Study Area, and therefore, the mass wasting potential would remain unchanged from existing conditions, as described in the Affected Environment section.

## 2.2 ALTERNATIVE 2

The proposed activities under Alternative 2 would have no effects on the existing geology within the White Pass Study Area since no mining for building materials or significant blasting is proposed. Proposed clearing and grading activities on certain Landtypes may however, have an effect on the mass wasting potential within the White Pass Study Area.

Processes that increase the probability of mass wasting would include reduction in soil stabilizing features (such as overlying vegetation), increased slope, increased surface or subsurface water flow, and exposure to avalanche paths. Although it is impossible to predict exactly where and when this type of process would occur, mass wasting would not likely be triggered by alterations in drainage or soil stabilizing features associated with implementation of Alternative 2.

Under Alternative 2, no clearing or grading would occur in landtypes B or C or in mapped Talus or Landslide Landtypes. In addition, surface and subsurface drainage patterns would not be affected by road building, culvert installation, or significant cut and fill grading, and therefore, the existing drainage network would largely remain intact. Areas within the White Pass Study Area that would be impacted through proposed clearing and grading activities would also be stabilized through Mitigation Measures (such as revegetation) to reduce mass wasting potential. Trail layout would be designed to minimize impacts to areas susceptible to mass wasting, and construction techniques (outlined in the Construction Plan) would follow recommendations of the geotechnical assessment for the project (refer to Mitigation Measure MM11 in Table 2.4-2 of the FEIS, Management Requirement MR4 in Table 2.4-3 of the FEIS, and Other Management Provisions OMP1, OMP2 and OMP4 in Table 2.4-4 of the FEIS). Therefore, human caused increases in mass wasting potential would be minimal as a result of the proposed activities under Alternative 2.

## 2.3 MODIFIED ALTERNATIVE 4

Similar to Alternative 2, the proposed activities under Modified Alternative 4 would have no effects on the existing geology within the White Pass Study Area since no mining for building materials or significant blasting is proposed.

Processes that increase the probability of mass wasting are as described under Alternative 2.

Under Modified Alternative 4, no clearing or grading would occur in mapped Landslide Landtypes. However, clearing and grading would occur approximately 50 feet upslope from a large Landslide area and within steep (greater than 60 percent) portions of Landtype B for the construction of trail 4-16 from the bottom of the proposed Hogback Express to the base of the Paradise Chair. The construction of trail 4-17 would occur in Landtype A and a small portion of Landtype B. Additionally, the grading for trail 4-18 would occur in steep (greater than 60 percent) portions of Landtype C and in a mapped Talus area. The construction of these trails could increase mass wasting potential if surface and shallow subsurface groundwater is not managed properly or if the cut and fill excavation is not engineered properly. As detailed in Management Requirement MR5 (Table 2.4-3), projects proposed in Landslide and Talus landtypes and on slopes steeper than 60 percent within landtypes B and C, a qualified engineer or geologist would assist in the final design of ski area facilities to minimize the effects of unstable slopes. MR5 would be implemented to minimize potential increases in mass wasting potential and limit the risk to infrastructure and guests (refer to Management Requirement MR5 in Table 2.4-3). Potential increases in mass wasting potential from this project would be further reduced through revegetation of exposed soils, and stopping work during large storm events. Trails would be designed to minimize impacts to areas susceptible to mass wasting (refer to Mitigation Measure MM11 in Table 2.4-2 of the FEIS, Management Requirement MR4 in Table 2.4-3 of the FEIS, and Other Management Provisions OMP1, OMP2 and OMP4 in Table 2.4-4 of the FEIS). Construction of a 7.0-acre parking lot in Landtype C would also occur under Modified Alternative 4. This proposed grading would be located in a low gradient (less than 15 percent) portion of Landtype C, therefore, increases in mass wasting potential are not expected.

## 2.4 ALTERNATIVE 6

Similar to Alternative 2, the proposed activities under Alternative 6 would have no effects on the existing geology within the White Pass Study Area since no mining for building materials or significant blasting is proposed.

Processes that increase the probability of mass wasting are as described under Alternative 2.

Under Alternative 6, no clearing or grading would occur in Landtype B or in mapped Talus or Landslide Landtypes. Approximately 2.5 acres of grading would occur in Landtype C for the proposed parking lot, however, the slope gradient in this area is less than 15 percent so increases in mass wasting potential are not likely. A permanent road is also proposed in Landtype A under Alternative 6 to access the bottom terminal of the proposed Basin Express from the existing ski area. The construction of the proposed road would require installation of four new culverts, two of which would be in perennial streams. Even though the proposed road and culverts would be located in Landtype A, site-specific engineering would be required to ensure that mass wasting potential would not be increased by changes in peak flow timing and magnitude and elevated debris torrent potential from improperly sized culverts (refer to Management Requirement MR5 in Table 2.4-3). Potential increases in mass wasting potential from implementation of Alternative 6 would be further reduced through revegetation of exposed soils, stopping work during large storm events, and trail layout would be designed to minimize impacts to areas susceptible to mass wasting (refer to Mitigation Measure MM11 in Table 2.4-2 of the FEIS, Management Requirement MR4 in Table 2.4-3 of the FEIS, and Other Management Provisions OMP1, OMP2 and OMP4 in Table 2.4-4 of the FEIS).

## 2.5 ALTERNATIVE 9

Similar to Alternative 2, the proposed activities under Alternative 9 would have no effects on the existing geology within the White Pass Study Area since no mining for building materials or significant blasting is proposed.

Processes that increase the probability of mass wasting are as described under Alternative 2.

Most of the 38.9 acres of clearing and grading proposed under Alternative 9 would occur on landtypes B and C. However, most of the proposed construction would take place on slopes between 15 and 30 percent, so increases in the mass wasting potential would be unlikely. Implementation of Mitigation Measures MM1, MM2, MM4, MM5, and MM6 would further reduce the potential for mass wasting in these areas. Construction of the proposed alternate egress route from the bottom terminal of the Paradise Chair to the base area would require cut and fill excavation on steep slopes (greater than 60 percent) in Landtype C. The construction of this trail could increase mass wasting potential if surface and shallow subsurface groundwater is not managed properly or if the cut and fill excavation is not engineered properly. A site-specific geotechnical analysis would be performed and incorporated into the construction plans for this trail in order to minimize potential increases in mass wasting potential and to limit the risk to infrastructure and guests (refer to Management Requirement MR5 in Table 2.4-3). Some of the proposed clearing and grading for the ski trails in the Paradise pod and the new Chair 5 pod in the eastern portion of the White Pass Study Area would occur on slopes from 30 to 60 percent. Geotechnical analysis would be required in these areas if slopes steeper than 60 percent are identified during final project design. Potential increases in mass wasting potential from these projects would be further reduced through revegetation of exposed soils, stopping work during large storm events, and trail layout would be designed to minimize impacts to areas susceptible to mass wasting (refer to Mitigation Measure MM11 in

Table 2.4-2 of the FEIS, Management Requirement MR4 in Table 2.4-3 of the FEIS, and Other Management Provisions OMP1, OMP2 and OMP4 in Table 2.4-4 of the FEIS). Specification would be provided in the Construction Plan.

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| TO: | White Pass MDP FEIS Project File |
| FROM: | Alex White |
| CC: | SE GROUP Project Files |
| DATE: | November 9, 2004 |
| RE: | White Pass MDP FEIS<br>Soil Compaction from Equipment Operation |

This memorandum has been prepared to assess the potential for compaction of soils due to the operation of construction equipment associated with the implementation of the White Pass MDP, which includes the construction of chairlifts, ski trails, a lodge, and utilities in the currently undisturbed Hogback Basin area. Specifically, this memo addresses management practices that could be implemented to prevent compaction of soils, and/or the creation of a *de facto* road where no actual road is proposed.

## 1.0 SOIL COMPACTION RESEARCH

The operation of construction equipment, such as trackhoes and bulldozers, has the potential to compact native soils along the travel corridor. For the proposed White Pass Ski Area Expansion, equipment would be required for the construction of chairlifts, the lodge, and the installation of utilities. This equipment would operate in proposed ski trails or the proposed chairlift line over snow or native ground during construction.

Froehlich et al. (1985) evaluated soil compaction due to logging in Idaho. Rates of recovery were studied on compacted skid trails on granitic soils and volcanic soils in mixed-conifer sites of west-central Idaho. Soil bulk densities were measured at 5.1-, 15.2-, and 30.5-cm depths and compared with adjacent undisturbed soil. Volcanic soils showed greater initial compaction than granitic soils. Recovery rates for the two soil types were not significantly different, however. After 23 years, only the surface 5.1 cm of granitic soil had returned to bulk density values equivalent to undisturbed values.

Research shows that soil densities approached their maximum after four to six machine passes and changed little with a greater number of passes (Zaborske 1989). These studies also found that there was a significant increase in soil density between 1-4 and 5-8 skidder passes and between 5-8 and 50+ passes (Zaborske 1989).

The type of equipment used would also influence the level of soil compaction. The ground pressure on soils from equipment tires can be decreased in three ways; increasing the tire diameter and width, increasing the number of wheels that a piece of equipment has, and by using smaller and lighter equipment. One way of protecting soils from compaction is to reduce the pressure on the soil from equipment tires through increasing flotation, which is done by increasing the size of tires or tracks to spread the machine weight over more surface area. Ground pressures of less than 5 or 6 pounds per square inch (psi) are often considered high flotation. The use of low pressure tires has been found to produce less compaction than conventional tires; however, even though the use of low pressure tires minimizes soil compaction, some compaction is still likely to occur (Blinn and Smidt World Wide Web 10/04).

Soil compaction along the root zone of undisturbed trees has the potential to reduce the viability of trees. The greatest impacts to remaining trees that closely border the designated travel route would be those trees that would have traffic on two or more sides of the tree trunk (Meeks World Wide Web 10/04). Compaction of soils in the root zone has been shown to inhibit root growth, and possibly tree mortality (Meeks World Wide Web 10/04).

# 2.0 MANAGEMENT PRACTICES TO REDUCE SOIL COMPACTION

To reduce soil compaction that would occur during construction activities, a Travel Route Plan (TRP) would be created to reduce the amount of soil compaction that would occur in activity areas during the construction of the *Basin Chair* and the *Hogback Express* and their associated trails and infrastructure. Soil compaction would be minimized by designating the use of specific travel corridors along constructed ski trails and lift corridors. Under the TRP, the layout of the trail network would be considered so that equipment would compact as little ground as possible with minimal maneuvering, and these trail areas would be clearly marked before any construction activities began.

The TRP, which would be incorporated into the Stormwater Pollution Prevention Plan (SWPPP) would designate flagging of the boundaries of the designated travel routes. Equipment would not be allowed to go over the same tracks more than three times, unless over snow. The designated travel corridor in a ski trail, lift line, or utility corridor, would be moved out of the previous travel corridor after three passes when no snowpack is present. In addition, under the TRP, no equipment (i.e., trackhoe, bulldozer, spider) would be allowed to travel within the drip lines of remaining trees, so that tree roots remain viable and productive.

Soil duff layers (twigs, needles, and other organic debris on the soil surface) can act as a cushion against the forces of heavy machinery. However, downed logs and trimmed tree limbs are more effective than duff or leaf litter in reducing compaction when laid in front of machines to serve as a cushioning mat, and more passes over slash would be required to cause the same changes in density than over bare soil, litter and duff layers (Zaborske 1989). Where possible, other measures that would be taken to reduce soil compaction include operation of the equipment over slash, downed logs, and tree limbs; driving vehicular equipment over frozen soils or soils covered with snow; and not operating the equipment over any part of the project area during wet weather conditions. These conditions would also be specified in the TRP and SWPPP. The TRP would permit equipment to be transported to the activity areas over snow covered ground in order to reduce the amount of soil compaction.

**Travel Route soil compaction reduction plan would specify that:**

- Travel corridors would be marked/flagged in field to limit the area in which equipment can travel during any period. After a maximum of three passes over any travel corridor that is not covered with snow, a new travel corridor would be established within ski trails or lift lines.
- When no snow is present, machinery would not operate within the drip lines of the trees on the immediate trail/liftline boundaries, or any trees to remain as tree islands.
- Low pressure tires/tracked equipment would be used throughout the construction areas to minimize soil compaction.
- If possible, equipment would operate over snow to the greatest extent possible.
- No machinery would travel over the project area during wet weather.

**Mitigation Measures/Management Requirements to be added to FEIS include:**

- A Travel Route Plan would be created for the SWPPP to limit equipment to designated portions travel ways.
- No vehicular equipment would be allowed over project area during wet conditions as specified in the SWPPP.
- Where possible, equipment would drive over slash, downed logs, or tree limbs to reduce soil compaction.
- Low pressure tires/tracks would be used by all equipment to reduce soil compaction.

## 3.0 LITERATURE CITED

Blinn, Charles R. and Smidt, Matthew. 2004. *Logging for the 21st Century: Protecting the Forest Environment.* University of Minnesota Extension Service. http://www.extension.umn.edu/distribution/naturalresources/DD6518.html#Soil

Froehlich, H. A., D. W. R. Miles and R. W. Robbins. 1985. *Soil Bulk Density Recovery on Compacted Skid Trails in Central Idaho.* Soil Sci. Soc. Am. J., 49:1015-1017.

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| TO: | White Pass MDP FEIS Project File |
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| DATE: | November 12, 2004 |
| RE: | White Pass MDP FEIS<br>White Pass Soil Groups |

Figure 3-6 of the FEIS illustrates the spatial variability of the major soil units within the White Pass Study Area. The soil groups utilized in this analysis are derived from the Gifford Pinchot National Forest's Soil Resource Inventory (USDA Forest Service 1977; 1992) and the Naches Area Soil Survey (USDA, USFS, 1996). A common soil group designation was chosen for the corresponding soil mapping units in situations where the same soil class was mapped and numbered differently on each Forest. The group number and geographic area of the soil group is displayed in Table 1.

Soil Group 1 consists of deep, well drained soils formed in volcanic ash mixed with colluvium from andesite (ashy, Typic Vitricryands), with local inclusions of deep soils derived from glacial deposits. Soil Group 1 covers approximately 191.6 acres and is usually found within valley bottoms and the toeslopes/footslopes of mountains (refer to Table 1). These soils are typically well drained sandy loams that range from shallow depths to greater than 40 inches deep. Locations where this soil group is found is on gentle slopes with high moisture content that have potential for surface erosion and moderate mass movement. Most of the existing base area support facilities and resort complex as well as the lower portions of the existing SUP area along Hwy. 12 have been developed on this soil group. While this soil group is the most easily re-vegetated in the White Pass Study Area, difficulty could be encountered because of the short growing season and low soil temperatures that may limit revegetation success on disturbed areas on these soils.

Soil Group 2 consists of deep, well drained soils formed in volcanic ash mixed with colluvium from rhyolite or pyroclastic rocks (ashy, Typic Udivitrands), and is usually found on the steep slopes, shoulders, and backslopes of mountains. These soils are typically well drained sandy loams that range from 15 to 40 inches deep. Locations where this soil group is typically found include steeper slopes that have potential for moderate to severe surface erosion and mass movement. Within the White Pass Study Area, this soil covers approximately 253.8 acres and is found along the cliff band that traverses the existing SUP (refer to Table 1). Revegetation on this soil type is difficult because of the low soil fertility, short growing season, and low soil temperatures that limit and revegetation success.

**Table 1:**
**Existing Soil Groups within the White Pass Study Area**

| Soil Group[a] | Area (acres) | Percent of White Pass Study Area |
|---|---|---|
| Group 1 | 191.6 | 12.2% |
| Group 2 | 253.8 | 16.2% |
| Group 3 | 356.0 | 22.7% |
| Group 4 | 541.4 | 34.4% |
| Group 5 | 180.0 | 11.5% |
| Group 6 | 22.4 | 1.4% |
| Group 7 | 24.8 | 1.6% |
| **Total** | **1570.0** | **100.0%** |

[a] Soil Groups are combined soil types based on similar soil units from the GPNF and the WNF soil mapping and therefore might be different from other figures or numbers.

Soil Group 3 covers 356.0 acres and consists of deep, well drained soils formed in volcanic ash mixed with andesite, volcanic rocks, and pyroclastic colluvium (Typic Vitricryands) that are usually found on the benches, shoulders, and toeslopes of mountains (refer to Table 1). These soils are typically well drained sandy loams or loamy sands that range from 15 to 60 inches deep. Soils in Soil Group 3 have potential for severe surface erosion, however mass movement is not considered a problem for these soils. This soil group is typically found at the summit of White Pass and the slopes surrounding the upper terminals. This soil group is typically found in areas with extended snow cover, so the combination of a short growing season, low fertility and cold soil temperatures, makes any revegetation of disturbed areas difficult.

Soil Group 4 is the most common soil group in the White Pass Study Area and covers approximately 541.4 acres (refer to Table 1). Soil group 4 consists of deep, well drained soils formed in volcanic ash mixed with volcanic rocks, and pyroclastic colluvium (Typic Vitricryands) that are usually found on the benches and shoulders of mountains. These soils are typically well drained loamy sands that range from 15 to 60 inches deep. Soils in Soil Group 4 have potential for moderate surface erosion, but mass movement is not generally considered a problem for these soils. Soil Group 4 is typically found within Pigtail Basin and most of the proposed expansion area and in areas with extended snow cover, so the combination of a short growing season, low fertility and cold soil temperatures, makes any revegetation of disturbed areas difficult.

Soil Group 5 consists of deep, well drained soils formed in volcanic ash mixed with volcanic rocks, and pyroclastic colluvium (Typic Vitricryands) that are usually found on the benches and slopes of mountains. These soils cover180 acres and are typically well drained loamy sands that range from 10 to 40 inches deep. Soils within Soil Group 5 are subject to high surface erosion, and there is moderate potential for mass movement as well. Soil Group 5 is typically found at Hogback Peak and its surrounding slopes. This soil group is typically found in areas with extended snow cover, so the combination of a short growing season, low fertility and cold soil temperatures, makes any revegetation of disturbed areas difficult.

Soil Group 6 is characterized by rock outcrops, talus fields, and rubble lands (former avalanche disturbance) and is mostly found on rugged, rocky landforms. This soil group is the least abundant soil group in the White Pass Study Area, covering 22.4 acres. Rock falls and debris slides are a considered hazardous because of the unstable and sometimes steep slopes. Soil Group 6 is typically found near the base area and other locations around the White Pass Study Area. Revegetation is almost impossible because of the topography and rocky conditions.

Soil Group 7 is water bodies which includes Leech Lake and some of the small ponds near the PCT at the summit of White Pass. Soil Group 7 covers approximately 24.8 acres within the White Pass Study Area.