CALIFORNIA STATE PARKS
Off-Highway Motor Vehicle Recreation Division

2008 GRANTS AND COOPERATIVE AGREEMENTS PROGRAM REGULATIONS

2008 SOIL CONSERVATION STANDARD AND GUIDELINES

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1.0. 2008 SOIL CONSERVATION STANDARD

In October 2004, Assembly Bill 2666 (Maldonado) was enacted, requiring the California State Parks (CSP), Off-Highway Motor Vehicle Recreation (OHMVR) Division to:

> "…update the 1991 Soil Conservation Guidelines and Standards to establish a generic and measurable soil conservation standard by March 1, 2006, at least sufficient to allow restoration of off-highway motor vehicle areas and trails." (Public Resources Code, Section 5090.35 (b)).

The Standard and supporting Guidelines are intended to ensure appropriate resource management and maintenance in areas of off-highway vehicle (OHV) use. They specifically apply to: (1) California's State Vehicular Recreation Areas (SVRAs); and, (2) all projects involving a ground disturbing activity that receive funding from the California OHV Grants and Cooperative Agreements Program.

1.1. 2008 Soil Conservation Standard

The 1991 document, entitled Soil Conservation Guidelines/Standards for Off-Highway Vehicle Recreation Management (California Department of Parks and Recreation, 1991), provided guidelines to achieve the following 1991 Standard:

> Off-highway motor vehicle areas and trails will be maintained in a condition that will allow for feasible rehabilitation by natural resource managers.

The updated 2008 Soil Conservation Guidelines for Off-Highway Vehicle Recreation Management (2008 Guidelines) have been prepared to support the following Soil Conservation Standard (2008 Standard):

> Off-highway vehicle (OHV) recreation facilities shall be managed for sustainable long-term prescribed use without generating soil loss that exceeds restorability, and without causing erosion or sedimentation which significantly affects resource values beyond the facilities. Management of OHV facilities shall occur in accordance with Public Resources Code, Sections 5090.2, 5090.35, and 5090.53.

Presented below are: statutes and regulations that apply to the 2008 Standard; minimum requirements applicable to the 2008 Standard; and definitions of terms in the 2008 Standard. These are followed by the 2008 Guidelines. The 2008 Guidelines provide tools and techniques that may be used to meet the 2008 Standard. Other tools and techniques that are more applicable to specific facility conditions and organizational protocols may be used as appropriate to comply with the 2008 Standard.

1.2. Applicable Statutes and Regulations

Section 5090.02 (c) of the Public Resources Code (PRC) states the California Legislature's intent with regard to soil conservation:

> 5090.02 (c)(1) Existing off-highway motor vehicle recreational areas, facilities, and opportunities should be expanded and managed in a manner consistent with this chapter, in particular to maintain sustained long-term use.
>
> 5090.02 (c)(2) New off-highway motor vehicle recreational areas, facilities, and opportunities should be provided and managed pursuant to this chapter in a manner that will sustain long-term use.
>
> 5090.02 (c)(4) When areas or trails or portions thereof cannot be maintained to appropriate established standards for sustained long-term use, they should be closed to use and repaired, to prevent accelerated erosion. Those areas should remain closed until they can be managed within the soil loss standard or should be closed and restored.

Implementation practices to meet the Soil Conservation Standard within SVRAs are in Section 5090.35 of the PRC, as presented below:

> 5090.35 (a) The protection of public safety, the appropriate utilization of lands, and the conservation of land resources are of the highest priority in the management of the SVRAs; and, accordingly, the Division shall promptly repair and continuously maintain areas and trails, anticipate and prevent accelerated and unnatural erosion, and restore lands damaged by erosion to the extent possible.
>
> 5090.35 (b)(2) Upon a determination that the soil conservation standards and habitat protection plans are not being met in any portion of any SVRA the Division shall temporarily close the noncompliant portion to repair and prevent accelerated erosion, until the soil conservation standards are met.
>
> 5090.35 (b)(3) Upon a determination that the soil conservation standards cannot be met in any portion of any SVRA the Division shall close and restore the noncompliant portion pursuant to Section 5090.11.
>
> 5090.35 (d) The Division shall monitor the condition of soils and wildlife habitat in each SVRA each year in order to determine whether the soil conservation standards and habitat protection programs are being met.
>
> 5090.35 (e) The Division shall not fund trail construction unless the trail is capable of complying with the conservation specifications prescribed in subdivisions (b) and (c). The Division shall not fund trail construction where conservation is not feasible.

Similarly, Section 5090.53 of the PRC states that no funds may be granted or expended under the Grants Program unless all of the following conditions are met:

> 5090.53(a) If the project involves a ground disturbing activity, the recipient has completed wildlife habitat and soil surveys and has prepared a wildlife habitat protection program to sustain a viable species composition for the project area.
>
> 5090.53(b) If the project involves a ground disturbing activity, the recipient agrees to monitor the condition of soils and wildlife in the project area each year in order to determine whether the soil conservation standards adopted pursuant to 5090.35 and the wildlife habitat protection program prepared pursuant to subdivision (a) are being met.
>
> 5090.53(c) If the project involves a ground disturbing activity, the recipient agrees that, whenever the soil conservation standards adopted pursuant to 5090.35 are not being met in any portion of a project area, the recipient shall close temporarily that noncompliant portion, to repair and prevent accelerated erosion, until the same soil conservation standards adopted pursuant to Section 5090.35 are met.

1.3. Minimum Requirements Applicable to the 2008 Standard

Projects funded by the OHV Trust Fund (PRC Section 5090.06) must be managed in accordance with the 2008 Standard. Assessment, maintenance and monitoring activities are necessary for any OHV project to ensure that an OHV facility is managed for its sustainable prescribed use, without generating soil loss that exceeds restorability, and without causing erosion or sedimentation which significantly affects resource values beyond the facilities. New projects must also incorporate design and construction elements. Documentation of the elements listed below is necessary to verify adherence to the 2008 Standard.

1.3.1. Assessment, Maintenance, and Monitoring

All OHV projects must have:

- A Protocol for Assessment and Maintenance which considers:
    - Water, Wind, and Mechanical Erosion
    - Water and Sediment Control
    - Tread Condition
    - Off-site impacts
    - Watercourse Crossings

- A Protocol for Monitoring Change Detection of Features, Trails, and Facilities which describes:
    - Objectives
    - Monitoring parameters
    - Monitoring site selection

    - Monitoring schedule
    - Data collection, including Quality Assurance/Quality Control measures
    - Data management

    And incorporates one or more of the following:

    - Photography (ground based and/or aerial)
    - Field Control Plots
    - Transects
    - Sampling Points

- A Compliance Report which includes:

    - Historical conditions
    - Change analysis
    - Findings
    - Conclusions
    - A Compliance Action Plan that describes:
        - Activities to be Implemented
        - Schedule of Activities

<u>1.3.2. Design and Construction</u>

A new OHV project shall be designed and constructed for the sustainable prescribed use of the project and associated facility, without generating soil loss that exceeds restorability, and without causing erosion or sedimentation which significantly affects resource values beyond the facility. Accordingly, the development of a new OHV project shall incorporate the following elements, as applicable:

- A Project Description that includes:
    - The Purpose of the proposed project
    - Documentation of the proposed project design, such as grading and/or construction plans
    - Proposed construction methods, including equipment and materials, and expected as-built documentation

- A Review of the potential effects of the project on:
    - Local hydrology, including watercourse crossings, hillslope erosion, and adjacent landscapes
    - Adjacent infrastructure, such as intersecting roads and staging areas

<u>1.3.3. Definitions of Terms in the 2008 Standard *</u>

Erosion: The wearing away of rock or soil by the detachment of soil or rock fragments by water, wind, ice, and other mechanical or chemical forces (CARC[1] 2006).

[1] Consulting Agency Review Committee

Facility: An OHV trail, track, road, corridor, SVRA, open-ride area, staging area, parking area (excluding structures) (CARC 2006).

Long-Term: At a minimum, 25 years.

Management: The coordinated implementation of budgeting, staffing, scheduling, design, construction, maintenance, monitoring and restoration activities at an OHV facility, as needed, combined with the effective utilization and coordination of resources, such as capital, labor, materials, and natural landscape, to achieve the soil conservation standard, and to ensure effective and efficient use of OHV recreational opportunities while protecting natural and cultural resources (CARC 2006 definition).

Off-Highway Vehicle: An off highway motor vehicle as specified in CVC Section 38006 and street licensed motor vehicles while being used off-highway.

Prescribed Use: The type of OHV activity at the facility, as established by the managing entity (CARC 2006).

Restoration: means, upon closure of the unit or any portion thereof, the restoration of land to the contours, the plant communities, and the plant covers comparable to those on surrounding lands or at least those that existed prior to off-highway motor vehicle use (PRC Sec. 5090.11).

Sedimentation: The process by which soils, debris and other materials are deposited, either on land or in water (CARC 2006).

Significant: Having a substantial or potentially substantial effect (CARC 2006).

Soil: All unconsolidated materials above bedrock; the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants; the unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors of climate (including water and temperature effects), and macro- and microorganisms, conditioned by relief, acting upon parent material over time. Soil differs from the material from which it is derived in many physical, chemical, biological and morphological properties and characteristics (AGI, Glossary of Geology, 1997).

Soil Loss: Movement of soil material to a location where the soil cannot be reasonably retrieved and/or recycled (CARC 2006).

Sustainable: The facility is managed to meet the soil conservation standard for a minimum service life of 25 years.

* See Appendix 1 of the 2008 Soil Conservation Guidelines for additional OHV-related definitions.

2.0. 2008 SOIL CONSERVATION GUIDELINES

The following Soil Conservation Guidelines (2008 Guidelines) provide resource management guidance for implementing the 2008 Soil Conservation Standard (2008 Standard) within California's State Vehicular Recreation Areas (SVRAs) and for projects on government lands that receive funds from the Off-Highway Vehicle (OHV) Trust Fund. The OHV activity includes all types of motor vehicles, including four-wheel drive (4WD), off-road motorcycles (MCs), all-terrain vehicles (ATVs), dune buggies, and snowmobiles. As mandated by state law, the 2008 Guidelines were developed with input from representatives from the California State Parks (CSP) Off-Highway Motor Vehicle Recreation (OHVMR) Division, Department of Conservation (DOC)/Department of Forestry and Fire Protection (CDF), Bureau of Land Management (BLM), U.S. Forest Service (USFS), U.S. Natural Resources Conservation Service (NRCS), and the U.S. Geological Survey (USGS). Through a series of public workshops, input was also obtained from representatives of approximately 30 other governmental organizations, OHV recreation groups, OHV industry consultants, and environmental communities.

2.1. Application of the 2008 Soil Conservation Guidelines

California's wide range of climate and vegetation, as well as its complex geologic and topographic landscape provides a variety of soil types with a broad range of associated engineering properties, which can make erosion control challenging. The 2008 Guidelines are broadly written to provide flexibility to allow their application to all OHV sites statewide. Because the 2008 Guidelines serve as resource management guidance for OHV use on prescribed trails and roads, multiple-use roads, and in open ride areas, it is the responsibility of the land manager to determine the recreational activity causing any specific resource damage and initiate the appropriate action. Recipients of funding from the California OHV Grants and Cooperative Agreements Program and SVRA managers, may use or modify the example guidance, or may create their own reporting forms as appropriate for their facility and/or organizational needs, as long as the various components of the guidelines are addressed in achieving the Minimum Requirements Applicable to the 2008 Standard (see Section 1.3).

2.2. Other Applicable Laws and Regulations

The 2008 Guidelines are to be used in conjunction with provisions of PRC 5090 et seq. and CCR 4970 et seq. for OHV use. However, it is the land managers' responsibility to recognize other local, state and federal laws and regulations that are applicable to the assessment and management of OHV areas, especially where unique environmental conditions exist. Examples include, but are not limited to: the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA); the Federal Water Pollution Control Act, commonly known as the Clean Water Act (CWA) and the California Porter-Cologne Act; the Federal Endangered Species Act (FESA) and the California Endangered Species Act (CESA); the Federal and State Clean Air Acts; statewide Airborne Toxic Control Measure (ATCM) regulation covering naturally occurring asbestos; federal, state, and local laws/ordinances that address erosion control and rider safety issues associated with mined land sites and other hazardous excavations within public lands used for OHV activities; the Resource Conservation and Recovery Act (RCRA), the Surface Mining Control and Reclamation Act (SMCRA), and the California Surface Mining and Reclamation Act (SMARA); the National Forest Management Act; and the Antiquities Act, the National Historic Preservation Act, the Archaeological Resources Protection Act, the Native American Graves Protection Act, and the American Indian Religious Freedom Act.

2.3. Assessment

An OHV soil conservation-related project (OHV project) could range from the installation of a properly designed watercourse crossing, to the decommissioning of a trail network which discharges excessive sediment to a watercourse, to the complete design, grading, and construction of a new OHV facility. Current regulations require that an OHV facility be planned, designed, constructed, and maintained with consideration for the ultimate long-term sustainable use of the land. This includes the possibility that there may be a change in land use. Proper assessment of area conditions prior to OHV project design affords the opportunity to design the project with sensitivity toward the long-term sustainability of OHV facility land. The following should be considered when area conditions are assessed for an OHV project.

2.3.1. General Information

- Scale and scope of the proposed OHV project. This will determine the necessary data needed to complete the project.

- Information regarding where the OHV facility is located and where the OHV project is proposed, including:

  - The OHV facility name.
  - The landowner and OHV facility manager.
  - Boundaries and total acreage of the OHV facility.
  - The county or counties in which the project is proposed.
  - Applicable land use and zoning regulations.

- Paper and/or GIS maps, aerial photographs and other imagery to convey location and physical setting of the OHV facility and proposed OHV project.

  - A regional scale map to show OHV facility and project locations.
  - Topographic maps of the project. The maps should contain equivalent information to that on a standard United States Geological Survey (USGS) topographic map. Specifically, the maps should:
    - Show the detail necessary to illustrate the project.
    - Depict slopes above and below the project.
    - Show watercourses and other special features within and/or adjacent to the project.

  - Depict the OHV road and trail network, including unofficial "volunteer" trails.
  - Show facility infrastructure such as parking and staging areas, camping areas, toilets, information kiosks, etc.
  - Have a scale of 1:24,000 (1" = 2,000') or larger. If the map is represented digitally, the base layer should be of a resolution that is the equivalent of or better than a United States Geological Survey (USGS) 7.5 minute topographic map.
  - Have a topographic contour line interval of 80 feet or less.
  - Show county lines and other jurisdictional boundaries.

- Recreational inventory and history of land use. Include a brief description of past, existing and proposed recreational activities at the facility and how the project reflects the OHV area management goals.

2.3.2. Previous Land Use and Hazard Considerations

Maps and other data regarding of previous land use within and adjacent to an OHV facility's boundaries, such as mining operations, military operations, and agricultural activities, provide important historical record that should be available for reference. This information may be important to an OHV project, particularly if the project requires soils to be disturbed. Identifying natural hazards such as potentially hazardous minerals (e.g., arsenic, asbestos, mercury), as well as landslides and active faults, is an important preliminary step to take when assessment activities for an OHV project are initiated.

Many former land uses and geologically hazardous conditions pose health and safety concerns. It is recommended that when evaluating lands with potential hazard- and health-related concerns, the OHV manager retain the assistance of a specialist trained, and as appropriate, licensed, to assess the applicable standards. Examples include specialists in abandoned mine land assessment, hazardous minerals assessment, industrial hygiene, and unexploded ordinance on formerly used defense sites. Personnel should not conduct field evaluations of such lands unless appropriately trained and/or accompanied by trained personnel familiar with the potential hazards at these types of facilities. Depending on concerns, evaluations regarding previous land use and hazard considerations should:

- Identify former mine sites located within and near an OHV facility, including the excavations, abandoned equipment, and tailings from the mine operations that may present physical or exposure hazards to OHV recreationists. Mine tailings may also present special erosion control considerations and/or environmental hazards to a watershed.
- Utilize services from a qualified, and as applicable, licensed, geologist or engineering geologist, to assist in identifying and assessing potentially hazardous features, such as landslides and active faults. When possible, such features are best avoided. If such sites cannot be avoided, then special considerations may be necessary to comply with applicable state and federal laws.

- Utilize services from an appropriately trained and, as applicable, licensed professional to identify and address potentially hazardous minerals, such as asbestos and mercury. If such areas cannot be avoided, then special considerations may be necessary to comply with applicable state and federal laws.
- Identify any industrial operations that used hazardous materials that may remain on the land or in the groundwater.
- Identify areas where military operations were conducted that may contain hazardous materials and unexploded ordnance.
- Identify past animal grazing and agricultural uses, where excessive, that may hinder vegetation from becoming established.
- Document the locations of the above features on a map. Include records of what the land use was, when it occurred, where it occurred, what human and/or environmental hazards may have been created, to what extent remediation was undertaken.
- Indicate whether the previous land use presents a current hazard or concern to OHV facility operations and erosion control.
- Provide the safety rationale and record for limiting access in certain areas of the OHV facility.

2.3.3. OHV Area Visitor Information

OHV area facility managers should know basic information about the visitors who frequent their OHV areas. This information is important to discern if a facility and its design are meeting the needs of the recreationists. If the facility is designed for the recreationists with intermediate skills but frequented by expert riders and drivers, volunteer trails may be created by visitors looking for more challenging routes. Conversely, beginning riders may jeopardize their safety when recreating within a facility designed predominantly for more skilled riders. To determine skill levels and other demographic data from the people who visit OHV areas, visitor information may be obtained in accordance with applicable state and federal agency policies and procedures. Regardless if whether survey data are available, the following demographic questions should be considered before proposing and implementing an OHV project at an OHV facility:

- What type(s) of vehicles access the area of the project?
- What is the designated skill level(s) of the trails and/or roads where the project is proposed?
- Are there other activities in the area of the project and should the design of the project consider these activities?
- What is the percentage breakdown of skill levels—beginner, intermediate, advanced—of the current visitors to the OHV facility, and how does that compare to the percentages of corresponding skill-rated trails, roads, and areas at the facility?

- With regard to staging areas, campgrounds, and parking, what are the percentage of day users at the OHV facility and the corresponding percentage of visitors who stay overnight?
- What are the desired future OHV opportunities at the facility?

2.3.4. Physiographic Data

An effective soil conservation-related OHV project maximizes soil retention, minimizes soil erosion, and needs minimal maintenance year-round, ensuring longevity. Depending on the scale of the project, a more detailed review of the physical setting of the OHV facility and the project site may be necessary. Topography, climate, geology and soils, vegetation, hydrology, air quality and wildlife should be considered in the design of an OHV project to ensure its longevity and effectiveness.

- Topography

    - OHV projects should be designed to blend with the surrounding landscape.
    - An analysis of topography can reveal landforms, such as landslides, which may impact a project's design and construction.
    - A topographic map should be used to illustrate the location of the project, slope steepness, slope orientation. Topographic features such as ridgelines, which define watershed boundaries, should be discernable.

- Climate

    - Seasonal weather extremes and seasonal operation of the OHV facility should be considered when planning an OHV project.
    - Precipitation can saturate hillsides, causing soil and slope instability by adding weight and reducing the cohesion of earthen materials.
    - Rapid snowmelt can overwhelm drainages and hillsides with runoff.
    - Lack of precipitation can create dust problems and prevent the establishment of vegetation
    - Lack of soil moisture can affect timing and techniques available for maintenance.
    - General and location-specific climatic data, including precipitation data necessary for erosion potential assessment and calculations (see Section 2.3.6), is available from a variety of sources, including the National Oceanic and Atmospheric Administration (NOAA), and the California Department of Water Resources (DWR).

- Geology and Soils

    - Assessment of geology is important when planning an OHV project as the type, distribution, and physical characteristics of the rock beneath an area may dictate the location and design of the project.
    - Assessment of geology includes a description of the rock type and its orientation to determine the relative stability of the rock type on a hillside. Geologic references, such as geologic, landslide, and mineral hazard maps, are available from the California Geological Survey (CGS) and the United States Geological Survey (USGS).
    - Equally important is the assessment of soil. The composition of the underlying rock determines the composition of the soil. The composition of the soil determines how well the soil will compact, how well it drains, and how resistant to erosion it is.
    - Soil surveys published by the Natural Resources Conservation Service (NRCS) provide data regarding soil type, description, distribution, description, engineering properties, drainage characteristics, and general thickness.

- Vegetation

    - Native vegetation and/or established vegetation should be incorporated in the assessment for an OHV project, for effective, cost-efficient erosion and sedimentation control. Native plants have adapted to their setting, adjusting to variations in climate and naturally available water.
    - The presence and effect of non-native vegetation should also be assessed. Non-native vegetation may be invasive, crowding out native vegetation.
    - Vegetation assessment should also incorporate an assessment for biological soil crusts, which form in arid and semi-arid regions where vegetative cover is sparse. These crusts consist of integrated communities of cyanobacteria, mosses, and lichens, and may constitute an area of environmental sensitivity.
    - Surface erosion protection from direct precipitation and from runoff water can be provided by native grasses, ground-covering brush, trees, and tree detritus, i.e., leaves, bark, fallen branches.
    - Botanical information and surveys of native vegetation and other plants are available on various internet sites, including the Online Floristic Interchange at the University of California, Berkeley (http://ucjeps.berkeley.edu/interchange.html). Additionally, most NRCS soil surveys indicate the native vegetation that typically grows in a particular soil. These data can be used to provide a general survey of vegetative cover for an area of concern.
    - Cultivation of local native plants and seeds using green houses and/or growing areas should be considered when planning a new OHV facility or redesigning a facility.

- Hydrology—Watersheds

    - The watershed boundaries that encircle the area must be known to assess the hydrology of an area and its surroundings,
    - For most purposes, the boundaries of a watershed can be delineated on a topographic map that has a scale of 1:24,000 and a topographic contour interval of 40 feet or less, such as most USGS 7.5 minute topographic maps. The map should provide enough detail to delineate the ridgelines that separate watersheds.
    - Drainage networks, the tributary systems of draws, creeks, and rivers that drain various watersheds within the area, should be illustrated along with other water bodies and features, such as lakes, ponds, springs, and marshes.
    - California watersheds of different scales have been defined by CalWater, a State and Federal interagency mapping committee (http://www.ca.nrcs.usda.gov/features/calwater/). Watersheds assessed for OHV projects should be consistent with the defined CalWater watersheds.

- Hydrology—Watercourse Types

    - Watercourses should be identified according to constancy of flow and the degree to which they support aquatic life and riparian species. The following watercourse types were derived from watercourse definitions provided in the previous Soil Conservation Guidelines/Standard document (DPR, 1991) and from the 2006 California Forest Practice Rules (Title 14, CCR, Ch. 4, 4.5 and 10). Individual agencies may use their own nomenclature for watercourse type but should explain how it corresponds with the definitions below.
        - Type I Watercourse: This watercourse can be 1) a fish-bearing stream, where fish are always or seasonally present, and includes habitat necessary for spawning and migration; or 2) a watercourse or spring that is consumed as a domestic supply where it is located within an OHV facility or within 100 feet downstream of the facility. A Type I watercourse is perennial (flows year-round) and is often referred to as blue-line drainage because this type of drainage is depicted on a USGS topographic map by a continuous blue line.
        - Type II Watercourse: This watercourse is a seasonal drainage. These drainages usually do not flow continuously throughout the year, but they do flow for an extended period of time beyond the rainy season. Therefore, these are often referred to as “intermittent” watercourses. Pools may be present throughout the year in these drainages, providing habitat for fish or other aquatic species, such as amphibians.
        - Type III Watercourse: This type of watercourse usually flows only in response to adequate rainfall or snowmelt. Consequently, it is

often called an “ephemeral” watercourse. A Type III watercourse does not support aquatic life. Type III watercourses may show evidence of sediment and debris transport from past debris flows or high-runoff events. If the topography appears to form a trough-like depression but does not show evidence of sediment or debris transport by runoff it is not considered a watercourse.

- Hydrology—Watercourse Protection Zones

    - To limit the amount of sediment that is unnaturally introduced into watercourses, the following buffers, or protection zones, may be used as a general guide for limiting OHV activity within the riparian corridor of the three watercourse types listed above, and in other wet areas, such as springs. These Protection Zone widths should be considered when designing new trails or watercourse crossings and in addressing problematic sections of existing trails. The Protection Zone widths listed below are not intended for OHVs on approach to designated watercourse crossings. These widths are presented as guidelines for protecting watercourses from sediment which may discharge from trails and roads that run parallel or sub parallel to watercourses. It may be appropriate to narrow or broaden the protection zones depending on the geomorphology of the watercourse banks, and the topographic and vegetative buffers between path and watercourse. If the protection zones are modified from the recommended widths, the modifications should be justifiable based on an assessment of the watercourse bank morphology and any other local conditions which may be pertinent.
        - Type I Watercourse Protection Zone: 100 feet from the closest edge of the watercourse channel
        - Type II Watercourse Protection Zone: 75 feet from the closest edge of the watercourse channel.
        - Type III Watercourse Protection Zone: Two ranges of protection zone measures to be defined by the OHV facility manager or designee and implemented when the watercourse is visibly flowing (more restrictive) and when it is not flowing (less restrictive).
        - Springs, marshes, and other wet areas: Springs and other wet areas are best avoided by establishing a protection zone of prohibited or limited OHV travel defined by the OHV facility manager or designee. If avoiding a wet area is impractical, then a raised causeway, such as a puncheon structure, may be appropriate.

- Hydrology—Watercourse Crossings

    - A simple technique to identify the number and location of watercourse crossings is a network analysis. A network analysis is a first approximation of locations where drainage and erosion control may be needed. The procedure consists of overlaying the drainage network with the trail network. Potential problem areas are identified where the two networks intersect (nodes). This analysis should be performed using maps that illustrate trail and road networks and, at the least, all Type I and Type II drainages. This analysis is most easily performed using electronic base maps and layers using a geographic information system (GIS) data management program. It can also be performed using paper maps and transparent overlays.

- Each crossing should be monitored consistently to determine its performance and the appropriateness of the crossing design to the crossing setting.
- Volumetric values necessary for proper watercourse crossing design should be determined by using hydrologic data from stream gauges, weather stations, and snow surveys within each watershed or sub-watershed. Public entities such as the USGS, NOAA, and DWR collect this data from many California watersheds. More location-specific data may be needed, which can be obtained by stream gauging and use of precipitation gauges.

- Hydrology—Water Quality

  - Discharge of sediment to a water body, such as a stream, river, or lake, is the primary water quality concern at an OHV facility. Additionally, petroleum products and other potentially hazardous chemicals may be spilled and seep into the ground water and/or drain to a water body at staging areas, camping facilities, and parking lots.
  - Each of California's nine Regional Water Quality Control Boards (RWQCBs) has developed a Basin Plan specific to its geographic region of regulatory authority. The Basin Plan identifies water quality concerns within the region, and it includes general mitigation measures to address those impacts.
  - Depending on local conditions and requirements, an OHV facility may need to have a water quality management plan.
  - If a listed water body in a Basin Plan is within or adjacent to an OHV facility, a water quality management plan should be developed that addresses those constituents of concern listed for that water body in the Basin Plan, as well as other water quality concerns specific to the facility.

- Air Quality

  - The California Air Resources Board web site (www.arb.ca.gov) provides contact information for Air Quality Management Districts and Air Pollution Control Districts throughout the state. These districts will have information about local air quality concerns that may apply to OHV areas.
  - General mitigation measures may be needed at an OHV area for dust control.

  - Naturally occurring minerals such as asbestos and silica may be exposed on ground surfaces at an OHV facility. There is a potential for OHV activity to disturb these minerals. When airborne, these minerals can be a health concern. Mitigation measures to control the airborne release of these minerals may be needed.

- Wildlife

  - There may be potential wildlife concerns with regard to an OHV project. Potential wildlife issues for an OHV facility can be assessed by first consulting the California Natural Diversity Data Base (CNDDB), maintained by the California Department of Fish and Game (DFG). The CNDDB can be accessed via the DFG website (www.dfg.ca.gov). The CNDDB provides information on various species of concern in California.
  - Additional assessment may entail the development of a Wildlife Habitat Protection Plan (WHPP). A WHPP includes a description and survey of threatened, endangered, and sensitive plants and wildlife and wildlife habitat in the area of OHV activity.
  - Depending on the species, avoidance or other protective measures may need to be implemented at an OHV facility to more effectively integrate the facility with its natural surroundings and inhabitants.
  - If a species of concern occurs in the vicinity of a project, studies regarding impact of the project on the species may be needed.

- Cultural and Historical Resources

  - Cultural and historical resources within or adjacent to an OHV project should be identified so that the OHV project can be designed to minimize potential impacts to the features.
  - Sensitive areas, such as habitat for endangered wildlife and vegetation, and paleontological (fossil) sites, should be known and delineated, if necessary. OHV access to these areas may need to be limited.
  - Open-ride-area OHV activity may need to be limited in vegetated areas.
  - The location and number of parking areas, campsites, and access routes should be minimized to reduce potential impact to the environment. These OHV facility features should be located on naturally flatter areas to minimize grading.

2.3.5. Erosion Potential Assessment

The primary purpose of an erosion potential assessment at an OHV facility is to identify areas which may be inherently more prone to erosion, and consequently may need specific drainage and erosion control design considerations. Several approaches can be used to estimate the potential for erosion on OHV facility lands. However, most large-scale methods of assessing erosion potential do not account for erosion susceptibility of trail tread. They are, however, useful in providing an assessment of erosion potential of broad landscapes on which a trail network may be planned or redesigned and are useful for assessing erosion potential within open-ride areas.

It should be noted that erosion of the trail tread is a function of the mechanical energy of the vehicle, the drainage controls on the trail and surrounding area, and the nature of the underlying soils. Therefore, with proper planning, design, construction, and maintenance a trail can perform well (exhibit little erosion) in an area that is naturally more sensitive to erosion; while a poorly planned, designed, constructed, or maintained trail may erode in an area that is not naturally prone to erosion.

Erosion potential assessment methods fall into two broad categories: empirical methods and analytical model methods. The two approaches offer specific advantages and may be used together or separately based on erosion potential assessment needs, size of the OHV project, and available information. It should be noted that the use of these methods requires specific expertise to obtain meaningful results.

- Empirical Methods of Erosion Potential Assessment—Observation

  - The empirical observation approach to erosion potential assessment uses historical aerial photography (air photos). This approach captures mass wasting erosion features such as debris flows, landslides, and rock falls that are not discerned by other methods of erosion potential assessment. Typically, historical air photos and other imagery covering the last 50 years are used in conjunction with soils maps and geologic maps to develop relative erosion and mass wasting susceptibility maps for a specific project area. This process can be accomplished manually with hard-copy images or digitally using GIS software. Each step described below helps to further define the erosion potential for an area.
    - The subject area is divided into regions of similar geology using a geologic map and an overlay map. If the available geologic map also illustrates active mass wasting features such as landslides, these features should be transferred onto the overlay map as their own regions. The overlay map is typically a topographic map. Its scale should be 1:24,000 or larger, with a contour interval of 40 feet or less.
    - The regions drawn onto the overlay map are subdivided into areas of the same soil using soil survey data available from the NRCS. Descriptions of soils in NRCS soil surveys typically include broad evaluations of erosion susceptibility for a soil type.
    - Each subdivided area on the topographic overlay is subdivided again according to slope gradient range, e.g., zero to 15 percent, 15 to 30 percent, etc. Steeper slopes are more prone to erosion processes.
    - The geomorphology of the subject area is analyzed using historical air photos and other imagery, such as topographic maps. Observed features mass wasting, such as denuded landslide

scarps and disrupted, irregular topography discerned from the images, is transferred onto the overlay map. If possible, features such as landslides mapped via aerial photographic review should be verified in the field.
    - Other soil and geologic references which regard the area of concern, particularly recently published geologic data, should be reviewed to determine if all factors regarding erosion potential have been catalogued and considered.

- Empirical Methods of Erosion Potential Assessment—Erosion Hazard Rating Computation

    - Checklists for erosion assessment have proven to be sufficiently representative for assessing the relative susceptibility of an area to erosion. The Erosion Hazard Rating (EHR) Computation Form (see the Training Manual) combines factors affecting erosion potential to appraise the relative risk of accelerated sheet and rill erosion. The system does not rate gully erosion, dry ravel, wind erosion, or mass wasting. The checklist was developed by an interagency team, under direction of the California Soil Survey Committee, to provide a consistent method for evaluating the likelihood that a soil disturbing activity will cause accelerated erosion.

    - The initial steps in applying the EHR Computation Form are the same as the first three steps bulleted in empirical observation method described above. These steps will define the subregions to which EHR calculations are applied. An EHR is calculated for each subregion. Subregion boundaries may be modified based on vegetation changes or other factors regarding ground cover.

- Empirical Methods of Erosion Potential Assessment—Watercourse Crossing Analysis

    - A watercourse crossing analysis is conducted by creating an overlay map that marks all points where trails and roads cross Types I, II, and III watercourses. This creates a watercourse/trail node map which illustrates locations where acute erosion due to poor watercourse crossing design may be occurring. This enables other empirical analyses, such as the review of aerial photographs or field observations, to focus on potential "trouble spots."

- Analytical Models for Erosion Potential Assessment—Revised Universal Soil Loss Equation

    - Analytical models are mathematical expressions used to predict erosion amounts and rates based on a simplified representation of natural processes. An advantage of analytical models is their ease of use (amenable to use in a spreadsheet). A primary drawback is that available models derive volumetric estimates of soil loss from sheet and rill erosion only. The Revised Universal Soil Loss Equation (RUSLE) is one of the most widely used analytical models for erosion assessment and prediction. It is a statistically derived equation used to predict average annual soil loss from hillslope elements in tons per acre per year. The RUSLE formula is:

$$A = R * K * L * S * C * P$$

Where: A = annual soil loss in tons per acre per year
R = rainfall erositivity factor
K = soil erodibility factor
L = slope length factor
S = slope gradient factor
C = cover management factor
P = erosion control practice factor

The erosion processes represented by these variables are similar to those used in the calculation of an EHR.

There are two versions of the RUSLE released by the U.S. Department of Agricultural. Version 2.0 of the RUSLE is for general, mostly agricultural purposes. Version 1.06 of the RUSLE is used in area of mine reclamation.

- Analytical Models for Erosion Potential Assessment—Water Erosion Prediction Program

    - The Water Erosion Prediction Program (WEPP) is a process-based model that employs a series of modules for weather generation, frozen soils, snow accumulation and melt, irrigation, infiltration, overland flow hydraulics, water balance, plant growth, residue decomposition, soil disturbance by tillage, consolidation, and erosion and deposition. These modules are ‘linked’ so that each module provides a piece of the input data for the soil erosion and deposition module.

- Analytical Models for Erosion Potential Assessment—Wind Erosion Prediction System

    - Wind erosion can be significant in arid regions and any area that has greatly reduced vegetative cover during a dry season. A wind erosion formula is used to estimate annual soil loss. The formula, known as the Wind Erosion Equation, or WEQ, is outlined below.

$$E = \int (ICKLV)$$

where: E = estimated average annual soil loss in tons/acre/year
∫ = the integration symbol which indicates relationships are non-linear
I = soil erodibility index
K = soil surface roughness factor
C = climatic factor
L = the unsheltered distance
V = the vegetative cover factor

Each variable in the WEQ is evaluated using a series of tables, maps, charts, and graphs developed for different regions of the country. Representative values for each variable are selected by the investigator and used in the equation to derive an estimate of soil loss in tons/acre/year.

A computer-aided model entitled the Wind Erosion Prediction System or WEPS (not to be confused with the WEPP Model) is also available. WEPS consists of a series of linked models of physical processes involved in wind erosion.

2.3.6. OHV Trail Condition Evaluation

The condition of OHV trails can be systematically evaluated using the Trail Condition Evaluation Form. This form can be used for an initial assessment of the condition of a trail or trail system. Repeated trail evaluations using the form will allow for monitoring of changes in trail conditions over time as discussed in Section 2.3. The form, abbreviated instructions for OHV trail condition evaluation, and criteria for assigning condition and cause codes used on the form are in Appendix 2 of this document. To provide statewide comparability and facilitate future statistical and programmatic analyses, users should not modify the form, but are encouraged to supplement the primary data collected when using the Form with information and data regarding conditions that are unique to a facility or important to a particular agency. General criteria for using the form are listed below.

- Prior to conducting the fieldwork using the form, information on the management of the OHV facility, the history of the facility and trail network, the current trail maintenance schedule and type of maintenance conducted, trail usage, skill rating assignments, existence of multiple-use roads, etc. should be obtained and reviewed.
- Trails are evaluated in segments. A trail segment is defined by the user of the form as any length that is practical and meaningful for monitoring.
- Criteria for making trail segments should be applied consistently over the entire trail network.
- The primary purpose of the form is to identify trail segments which need more focused maintenance or reconditioning. Data collected from the form also provides the basis for a monitoring program.

- To assist in consistent data entry on forms used at an OHV facility, the facility manager is encouraged to develop a series of facility-specific calibration cards. These cards consist of photographs of typical Green (acceptable), Yellow (marginal), and Red (action needed) conditions that might be found at the facility.
- Particular attention should be paid to trail and road intersections to evaluate whether one system is negatively affecting the other.
- Off-trail or off-site impacts may require a more detailed evaluation by an appropriately qualified professional.

2.4. Trail and Road Maintenance

Consistent observation and appropriate preventative action is the basis for conducting proper maintenance of trails and roads at an OHV facility. Equipment used for maintenance tasks, from heavy machinery to shovels, should be appropriate to the tasks. Large, conventional earth-moving equipment, such as bulldozers and road graders, are generally not appropriate for OHV trail maintenance. Personnel operating equipment used in maintenance activities should be sufficiently experienced, competent, and, as appropriate, qualified to use of the equipment.

To ensure consistent, appropriate maintenance is conducted at an OHV facility, a maintenance plan should be developed and implemented by the OHV facility manager. The maintenance plan should be modified over progressive seasons to address chronic maintenance problems and the need to change maintenance approaches in some areas of the facility.

2.4.1. Maintenance Planning and Implementation

Considerations in the development and implementation of a maintenance plan, as well as general maintenance activities, are detailed below.

- The maintenance plan should provide a process to rectify deficiencies in trail design or construction, as well as changing impacts to the trail by such things as increased trail use.
- Maintenance for OHV trails should be conducted with deference to the skill rating of the trail. An expert trail may look “ugly,” to the casual observer but this may be due to features on the trail that qualify it for an expert skill rating. Maintenance may not be needed on such a trail if it is stable and not creating drainage or sedimentation problems and is otherwise in compliance with the Soil Conservation Standard.
- The consistent documentation of observations and fieldwork conducted as part of an OHV facility maintenance plan can form the basis of an ongoing road and trail monitoring program.
- The maintenance plan should be available to all pertinent personnel so that maintenance activities can be coordinated, conducted and documented properly.
- Applicable OHV guidelines in this document should be consulted when constructing, maintaining, or reconditioning trails and trail features.

- At failed drainage structures, the cause of failure should be determined before repairs are initiated. This may require input from qualified experts.
- Ideally, maintenance that entails compaction of soil should not be conducted if soil moisture is too wet or too dry.
- Sediment that has accumulated in waterbreak (e.g., rolling dip) outlets should be removed and used for trail structure needs, such as rebuilding the crests between rolling dip troughs.
- Outside berms should be minimized or eliminated. However, they should not be "bladed" off the trail as sidecast. Berm materials should be pulled back and graded into the trail tread.
- Rills and gullies in trail treads should be repaired with soil reclaimed from waterbreak outlets and outside berms. Soil should not be scraped from the trail tread to fill rills and gullies.
- Soil and rock that may have sloughed onto a road or trail from a roadcut should be graded smooth to make a safe trail. The earth materials should not necessarily be removed because they may be providing a stabilizing buttress to the roadcut. In some cases, analysis by a qualified expert may be needed.
- Repair of "whoops" or "stutter" bumps should be conducted by ripping the trail tread and regrading. Earth materials should be graded and compacted back into the trail tread when the moisture content of the materials is at or near optimal to allow for proper compaction.
- Any road or trail maintenance objective should be conducted by moving the smallest amount of soil necessary to meet the objective.
- The need for maintenance with mechanical equipment should be evaluated before equipment is mobilized to the maintenance site.
- Maintenance equipment should be transported across sections of trail that do not need maintenance without impacting those sections.

2.4.2. Documentation of Maintenance Activities

Documentation of maintenance activities allows for a more thorough evaluation of the effectiveness of the maintenance. A form regarding trail maintenance is presented in Appendix 3 of these guidelines as examples of the type of documentation that should be collected when trail maintenance activities are scheduled and conducted. The Mechanized Construction - Maintenance Checklist Form should be completed within a few days of completing scheduled maintenance. The Implementation and Effectiveness Evaluation Form should be completed following one season of trail use. It may be beneficial to have appropriately trained and qualified earth science professionals, such as soil scientists, hydrologists, or geologists, to evaluate the effectiveness of maintenance activities.

2.5. Protocol for Monitoring

A proper protocol for monitoring at an OHV facility will determine if the facility has been designed, constructed, and maintained to limit soil erosion, promote sustainability, and prevent sediment delivery to water bodies. A monitoring program developed according to the protocol will readily detect and, if necessary, quantify, changes to features of the road and trail networks at the facility. Detected changes can then be evaluated to determine if specific features need to be modified or replaced to bring a trail, trail network, or area into compliance with the Soil Conservation Standard.

2.5.1. The Monitoring Plan

As part of the monitoring protocol, a Monitoring Plan should be developed that effectively detects changes at an OHV facility. To achieve this, the Monitoring Plan should stipulate:

- Monitoring objectives. The purpose of the monitoring effort should be clear. Monitoring objectives should discern if the features of an OHV facility are functioning properly and, if necessary, should address special requirements imposed by regulatory bodies and by local, state, or federal statutes, regulations, and rulings.
- Monitoring parameters and site selection. The Monitoring Plan should stipulate the features to be monitored, and how they are to be monitored. The scope of the monitoring effort should be appropriate to the size, type, and use of the OHV facility and be manageable within the limits of facility staff and budget. The following types of monitoring should be considered when developing monitoring parameters:

    - Implementation monitoring. Used to determine whether activities were conducted as planned.
    - Forensic monitoring. Used to identify causes of acute erosion and sedimentation.
    - Effectiveness monitoring. Used to determine if design, construction, and maintenance practices are adequate.
    - Compliance monitoring. Used to determine if land-use activities are in compliance with applicable regulatory standards.
    - Assessment monitoring. Used to characterize existing conditions.
    - Trend monitoring. Used to characterize any change in conditions over time.

- Appropriately trained and qualified personnel. Depending on the types of monitoring tasks to be conducted, the personnel charged with conducting monitoring activities may need specific training and qualifications to conduct specific tasks.
- Monitoring program design. A monitoring program should be designed so that it can be implemented effectively and conducted consistently within the constraints of budget and staff capabilities.
- A schedule of monitoring activities. Specific monitoring activities should be scheduled as appropriate—quarterly, seasonally, before or after peak use of the OHV facility, etc. Monitoring activities should also be prioritized based on potential detrimental impacts from feature failure and on available personnel.

- General field observations. The OHV facility should be toured by monitoring personnel throughout the year to determine if monitoring schedules need to be modified or if additional features should be monitored. Observations to determine feature functionality are best made during or shortly after seasonal extremes, and during peak use of the OHV facility.
- Proper data collection techniques, with quality assurance/quality control measures (QA/QC). The Monitoring Plan should stipulate the type of data that is to be gathered from the monitoring activities and how the data are to be collected and recorded. Appropriate selection and training of monitoring personnel will ensure that data is collected in a consistent manner. A small percentage of duplicate sampling by different individuals (generally about 10 percent) will provide a QA/QC check on the data collected.
- Instruction for appropriate management of collected data. The monitoring plan should also describe the data management system for monitoring activities—how collected data will be stored, managed, and accessed for future uses. Databases are often used as data management systems because they can be customized to store different types of data and can integrate with GIS software. GIS software enables versatile geographic representation of collected data. Data entry into a data management system should be conducted concurrent to fieldwork or shortly thereafter. Data entry should not be delayed more than one month beyond the time data were collected.

<u>2.5.2. Change Detection Methodology—General Considerations</u>

The monitoring program should employ one or more of the following to detect and quantify changes:

- Photographic analysis and comparison with photographic record
- Field control plots to make comparisons with disturbed and undisturbed areas with similar physical properties.
- Longitudinal and transverse profile plots of trail and road segments
- Recurrent point sampling

<u>2.5.3. Change Detection Methodology—Monitoring for Specific Environments and OHV Activities</u>

Some environments, and some OHV activities, should have change detection monitoring suited to the specific environment and activity, as detailed in the following sections.

- Monitoring Open Ride Areas. Open-ride areas are expansive areas used by OHVs, where vehicle use is not limited to specific routes. Almost any portion of an open-ride area may become impacted by excessive OHV traffic. The following tiered monitoring approach will allow adverse impacts in and adjacent to the open-ride area to be identified.

- Tier one change detection—boundary monitoring of the open-ride area. Monitoring at this level should focus on the interaction of the open-ride area and its surroundings.
- Tier two change detection—monitoring areas of concentrated OHV activity and general use. Staging areas, camping areas, and specific OHV recreation features such as hill climbs, should be monitored at this level.
- Tier three change detection—monitoring specific features. Specific common riding sections with potential erosion problems, watercourse crossings, and environmentally sensitive areas, such as habitat for endangered plants and animals should be monitored at this level.

- Monitoring Dunes and Desert Sand Environments. Depending on conditions, dunes and desert sand environments can be fragile. Recovery of these environments, if damaged, can be lengthy. Monitoring activities should be designed specifically to evaluate impacts of OHVs on sensitive areas within the dune and desert sand environments. This may require comparative monitoring using fenced-off areas where no OHV-related disturbances occur as reference (i.e. control plot monitoring). Any monitoring effort should acknowledge and be designed to account for, as appropriate, factors such as wind transport of sediment and seasonal deluging from desert washes.

- Monitoring for OHV Special Events and Races. Special events and races at an OHV facility can strain the infrastructure and environment at the facility. This is because concentrated numbers of people congregate for the events, and in many cases aggressive, repeated runs occur on the event courses by competitors. OHV courses for special events and races are designed as either point-to-point routes or are on closed-loop routes. Competitions include cross-country races, enduros, dual sports, hare-and-hound races, trials riding, rock climbs, obstacle course contests for four-wheel-drive vehicles, and motocross races on closed-loop courses. Some monitoring considerations for OHV special events and races include:

    - Runoff drainage should be monitored for volume and sediment load at fixed facilities, such as tracks and staging areas. Monitoring results may determine the need for runoff drainage holding facilities (i.e. sediment ponds).
    - Climate considerations should be made prior to an event. Depending on the type of event and course conditions. For example, it may be necessary to postpone or cancel an event due to excessive precipitation.
    - For temporary facilities, such as cross-country racecourses, monitoring should be conducted at each watercourse crossing and at randomly selected racecourse segments. Types of monitoring at these locations include:
        - Photos taken before the event and after reconditioning has been completed.

- Turbidity monitoring down-stream from select watercourse crossings, before, during, and after an event.

2.5.4. Compliance Reporting

Finally, the monitoring program should employ a method for consistent reporting and analysis of data collected. The monitoring reports will provide a record to validate compliance with the Soil Conservation Standard, and with an OHV facility's maintenance plan. In general, a monitoring report should include:

- A description of current and historical conditions at the OHV facility or other area being monitored.
- Description and analysis of detected changes.
- Additional findings.
- Conclusions based on analysis of detected changes and additional findings.
- Recommendations based on conclusions. Recommendations should be in the form of an action plan. The action plan should detail activities to be implemented and include a schedule of implementation. The action plan should be distributed to the appropriate responsible parties at an OHV facility, such as the facility manager and trail maintenance personnel.

2.6. Project Design and Construction

The purpose of this section is to provide basic design criteria that should be considered when an OHV Project is proposed and constructed. The intent of all design criteria discussed is to prevent or limit erosion and to promote soil conservation at OHV facilities.

2.6.1. Project Design Considerations

An OHV project as a whole should be sustainable per the Soil Conservation Standard and should minimally impact the landscape on which it is constructed. Project design should therefore not commence before such assessment activities as discussed above are conducted and available for review.

The design of an OHV project should not significantly alter or impact the local watershed where the project is proposed--watercourses, hillslope runoff, and native vegetation should be minimally affected. To achieve this ideal, OHV projects should be designed using the principles of hydrologic invisibility and hydrologic disconnection.

An OHV project designed with the principles of hydrologic invisibility allows runoff water to flow in a natural pattern down a slope and across the trail or road tread surface—not along the tread—as it continues downslope. Thus a hydrologically invisible trail or road avoids unnatural concentration of flows, and disperses concentrated runoff before it accumulates to volumes and velocities that can cause erosion. A project designed for hydrologic disconnection incorporates design elements of hydrologic invisibility on a network-wide level to ensure water in a watershed or subwatershed exits the watershed basin naturally, at the low point, or mouth, of the basin. Ridge tops and stream crossings are critical points for maintaining hydrologic disconnection: The lowest point of any trail or road in a basin should be at the watercourse crossing. If this is not the case, then the trail or road network has the potential to intercept and divert water from the natural channel. The highest point of any trail or road that traverses a ridge should be at the point where the trail or road intersects with the ridgeline. This ensures that runoff water will still flow away from the ridgeline, keeping adjacent watersheds disconnected. Aspects to consider regarding physical setting and layout of roads and trails are detailed below.

- OHV Trails and Roads—General Design Considerations

    - Trails and roads designed to follow the principles of hydrologic invisibility will be less susceptible to erosion.
    - Design features which promote hydrologic invisibility include outsloping, rolling tread profiles, and rolling dips.
    - Culverts, inside ditches, and similar drainage control features require frequent maintenance, hindering the sustainability of trails and roads, and generally should not be used if alternatives that better adhere to the principles of hydrologic invisibility and disconnection are feasible.
    - A trail or road should not be designed with a sustained uniform grade, including level or near-level grades. Runoff water will flow along a sustained grade, gaining velocity, volume, and erosive force.
    - The layout and grade of a trail or road should be designed to minimize the creation and size of cuts made into the natural grade of the landscape (cut-slopes). An engineer or geologist may need to be consulted to determine the suitability and stability of larger, steeper cut-slopes.
    - Trail and road networks should be designed to avoid known unstable areas such as landslides and earthflows. Trails and roads crossing unstable ground typically require extraordinary construction and maintenance costs. If an unstable area is unavoidable, an engineer or geologist should be consulted to determine proper layout and design of the trail or road.

- Specific Design Considerations—OHV Trails.

    Successful trail design integrates numerous factors encompassing visitor satisfaction, hydrology, trail durability, construction technique, and ease of maintenance. Trail-specific design considerations include:

    - Trail types, difficulty, and length should be appropriately mixed to provide visitor satisfaction and potentially minimize the creation “volunteer” trails by dissatisfied recreationists.

   - Trails should not “dead end” or have major velocity changes at turns solely contained by hillslopes. Both of these conditions can lead to volunteer trails and hill climbs departing from these points.
   - Trail durability can be enhanced by routing the trail over erosion resistant soils and rock.
   - To avoid cascading erosion and cumulative sedimentation, trails should not be designed with vertically stacked switchbacks
   - The layout design of closely-spaced parallel trails should be avoided to prevent recreationists-created trails which connect the parallel trails.

- Specific Design Considerations—Multi-Purpose Roads.

  Multi-purpose roads within OHV facilities must be usable by a wide range of vehicles, including general transportation, utility, and emergency vehicles. Consequently, multi-purpose roads will not typically offer a challenge to the OHV recreationists as they must be designed to allow efficient conveyance of non-recreational vehicles. Some design considerations for multi-purpose roads are listed below.

   - The layout of a multi-purpose road within an OHV facility should be designed for minimal length while still adhering to the principles of hydrologic invisibility and hydrologic disconnection.
   - If possible, a multi-purpose road should be located on the periphery of an OHV area.
   - Runoff from a multi-purpose road should not be intercepted by or otherwise diverted to an OHV road or trail.
   - The surface of a multi-purpose road must be durable. Appropriate surfacing with crushed rock, or other amendments, will improve load capacity of the road and smooth the running surface of the road.

2.6.2. Project Design Features

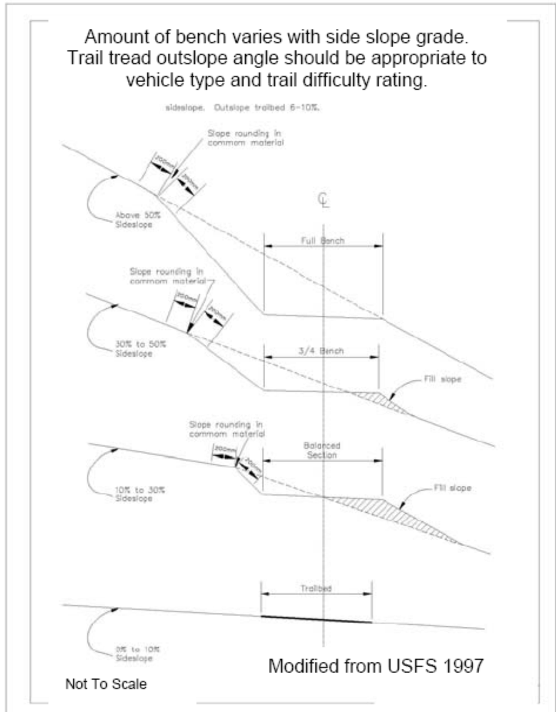
An OHV project is a mix of different design features. Which features are incorporated depends on the management objective(s) for that project. Different design features are presented below, along with criteria to consider when incorporating these features into a project.

- Trail Tread Design

   - The width of trail tread that is designed for OHV recreation should be based on the type of vehicle expected on the trail (motorcycle, ATV, 4x4), the intended skill rating for the trail (less skilled operators require a wider tread for safety), and the topography on which the trail or road will be graded. Typical recommended widths are:

DESIGNATED USE	TREAD WIDTH (INCHES)
Motorcycle - most difficult	12 – 18
Motorcycle – more difficult	18 – 24
Motorcycle – easiest	24 – 30
ATV - most difficult	48 – 60
ATV – more difficult	60 – 72
ATV – easiest	72 – 86
4X4 - most difficult	72 – 84
4X4 – more difficult	84 – 96
4X4 – easiest	96 -120

- To achieve desired trail tread width, the following grading practices, as illustrated in the figure below, are recommended based on adjacent topography:
    - The trail tread should be integrated with designed drainage control measures to retain hydrologic invisibility and hydrologic disconnection.
    - To maintain hydrologic invisibility, trail tread should not be insloped. Insloped trails capture runoff and promote erosion.
    - Trail tread subject to high usage and/or other potentially intense erosive forces can be protected by treating with a soil amendment and/or armoring with hardened materials such as properly installed paver stones, gravel, or native rock.
    - It should be anticipated that berms may form on the outside edge of a trail. Periodic maintenance measures to breach the berm at regular intervals or grade the berm material back into the trail tread should be anticipated.

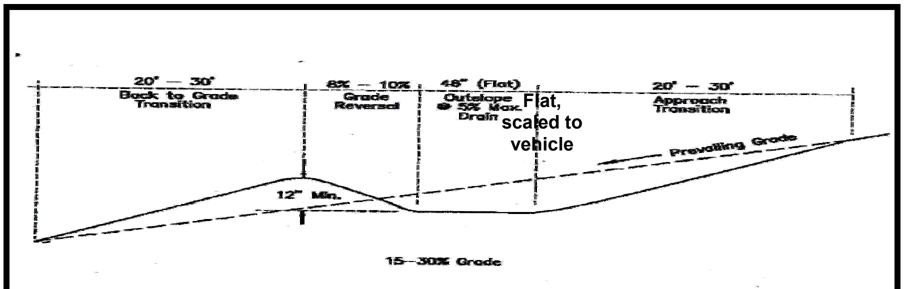


- Rolling Profile
  - The primary benefit of a rolling profile is that it prevents long steady trail grades which capture and convey runoff.
  - Rolling a trail profile allows the traveled path of the trail to vary or undulate.
  - Inclusion and placement of the crests and troughs of the rolling profile is a primary design decision made when a trail or road network is planned for construction or realignment.
  - A rolling profile prevents the creation of long, sustained trail grades, along which runoff drainage can flow, gaining velocity and volume and erosive force.
  - Local topography, as well as natural features such as rock outcrops and trees, can be used as “pivot points” on the trail layout, making the trail more effective and challenging to the OHV recreationist.

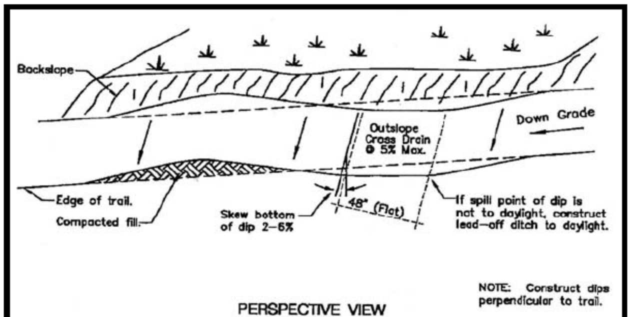
- Rolling Dips
  - Rolling dips are broad undulations graded into a trail or road. Rolling dips may be built into a new trail or road, or retrofitted to an existing one.
  - Rolling dips are usually placed in series on descending paths so that runoff volume is sufficiently dispersed off the path.
  - Reinforcement measures, such as rock armoring, can be used at the rolling dip trough outlet to minimize erosion.
  - Rolling dips are used for drainage control and should not be considered as features for OHV recreation—they are not intended as jumps for OHVs.

Ideally, the trough length of a rolling dip is long enough so that spinning wheels of OHVs do not gouge the trail tread and alter the effectiveness of the rolling dip. Many factors dictate the appropriate spacing and dimensions of rolling dips, road steepness being the most important. The speed of OHV traffic on a trail is also important—rolling dips dimensions should generally be more elongated with faster traffic. As a general rule, rolling dip troughs should be at least as long as the average wheelbase of vehicles on the trail or road. For example, if a trail is intended for motorcycles only, and the typical motorcycle wheelbase is 55 inches, then the trough flat on a rolling dip should be approximately 55 inches. The figures below provide examples of basic rolling dip design.

- Rolling dips are nearly always installed in series so that any one rolling dip is not diverting too much runoff, which may lead to an additional erosion problem.



Rolling Dip Profile



GENERAL NOTES:

1. Drain should be relatively flat in relation to existing grade, allowing water to slow down and drop sediment before it exits the trail. Drain should be outsloped 2% to 5% to drain effectively. By having a wider and flatter drain exit, water will be dispersed and slowed reducing the possibility of erosion. Sediment basins or other flow dispersal devices may be necessary to prevent off-site transport of eroded soil or erosion of off-site materials being eroded due to increased water flow.

2. Both the drain section and the reversal of grade section (berm) should be nearly square (90°) to the direction of travel. If the berm is angled in relation to the direction of travel, it may be difficult for motorcycles and ATV's to negotiate under wet conditions or at higher speeds.

3. The intent is to create a drainage structure that the vehicle flows through rather than having abrupt changes in grade for the vehicle to negotiate. This will result in a longer lasting structure that is less susceptible to mechanical erosion.

- Waterbreaks
    - A waterbreak is a design feature that diverts concentrated water from a trail or road tread. It may be a ditch, dike, or dip, or a combination thereof, which is constructed diagonally across the trail or road so that water flow is effectively diverted from the tread.
    - Prior to installing waterbreaks it is important to evaluate the conditions that caused the acute erosion. Many times, a water diversionary structure placed strategically on or adjacent to the trail path at the top of a slope can mitigate the problem.
    - Waterbreaks are nearly always installed in series so that any one waterbreak is not diverting too much runoff, which may lead to an additional erosion problem.
    - The spinning wheels of OHVs eventually obliterate the waterbreaks. More durable waterbreaks can be made by mixing soil with rock in the waterbreak core and/or adding a soil amendment such as cement or bentonite. Waterbreaks may also be hardened by positioning pre-formed concrete blocks known as "dogbones", along the waterbreak crests. On-site materials, such as rock or timber, can be used if sufficient amounts of soil are unavailable.
    - The installation of flexible waterbreaks may be appropriate for some trail conditions.

- Drain Dips
    - A drain dip acutely tilts the trail to facilitate runoff drainage.
    - Drain dips are usually cut into the grade of an existing trail or road.
    - Drain dips are typically used on low gradient trails.
    - Drain dips should be considered where trails run into a swale or hollow in the landscape to promote hydrologic invisibility.
    - Use of drain dips can be a very effective drainage control measure on incised trails or roads, but the drain dips should be routinely monitored and maintained to ensure effectiveness.

- Climbing Turns
    - To avoid cascading erosion and cumulative sedimentation, trails should not be designed with vertically stacked switchbacks. Instead climbing turns should be employed. Climbing turns differ from switchbacks in that they have a larger radius of turn (10 feet or more), with gradients up to 25 percent.
    - Climbing turns are designed with as large a radius as is practicable. The larger the turn radius, the greater the separation distance between upper

and lower limbs of the turn. This provides more ground for dispersing drainage.
    - Climbing turns are typically banked. Trail drainage that flows around the banked turns should be diverted from the trail tread immediately above and below the turn, where the trail section between turns is relatively straight. Drainage diverted off-trail should be sufficiently dispersed so that the drainage does not flow onto any lower portion of trail.
    - Sequential climbing turns should be laid out so that the trail grade climbs a slope laterally.
    - Climbing turns should be designed to minimize excavation and cut-slope exposure.

- Watercourse Crossings

    - A properly designed watercourse crossing allows water to remain in the watercourse and does not alter, or only slightly alters, the gradient of the watercourse at the crossing.
    - To prevent all or part of a watercourse from diverting onto a trail, the trail at the watercourse crossing should be lower than the trail segments that approach the crossing on either side, adhering to the principal of hydrologic disconnection discussed earlier.
    - There are many watercourse crossing designs, from rocked fords to culverts to bridges. Each watercourse crossing must be designed based on the anticipated flood flows of the watercourse it crosses, and, as appropriate, for fish and other aquatic species passage. Not all designs are appropriate for any one crossing.
    - Approaches to watercourse crossings should be designed according to the principles of hydrologic invisibility and hydrologic disconnection to minimize sediment delivery to the watercourses. Adequate drainage features such as grade breaks, outsloping, waterbreaks, and rolling dips should be incorporated on each approach limb so that runoff water is diverted off-trail and not conveyed along the path to the watercourse. The approaches should not be incised.

- Parking Areas, Staging Areas, and Other Large Surface Areas

    - Parking lots, staging areas, campgrounds and picnic areas, pits at race tracks, and maintenance facilities all have large surface areas which must be drained without causing erosion or excessive soil loss.
    - Options to prevent or limit erosion of a large surface area include:
        - Compaction of earth materials. This option entails scarifying the native surface, applying water to the earth materials as needed for proper compaction of soil, and compacting the soil to an engineering standard based on anticipated loads of the surface area. Typically, soil is compacted to at least 90 percent of the soil's maximum density

    - Paving. This option is expensive and not appropriate for many settings. Areas to be paved are usually prepared by compaction of earth materials as described above. A compacted crushed rock cover is also applied to the surface before paving if traffic load is anticipated to be heavy.
    - Crushed rock cover. This option is slightly more aesthetic than paving, and cheaper and more easily applied to different settings. Native surface areas may or may not be compacted prior to being covered with crushed rock.
  - Regardless of the surface area treatment chosen, surface runoff should not accumulate excessively as concentrated flow.
  - Drainage design of the surface area should incorporate multiple drainage swales to disperse runoff to multiple locations around the open area.
  - Runoff conveyance and discharge points should be well armored with rock to avoid erosion during storm events.
  - Land surfaces that slope gently away from large surface areas should be used to disperse surface area runoff.
  - If natural land surfaces suitable for dispersing runoff water are not in the vicinity of the large surface area, the construction a runoff control feature, such as a man-made containment or filtering feature, should be considered.
  - Runoff should not be discharged directly to a watercourse.
  - Runoff that is discharged to a watercourse may require, at a minimum, a National Pollution Discharge Elimination System (NPDES) permit or waiver.

<u>2.6.3. Designing for Specific Environments and OHV Activities</u>

Considerations which should be made when designing OHV projects within specific environments and designing for OHV event activities, such as competitions, is discussed below.

- Open-Ride Areas. All or part of an OHV facility that does not restrict OHV traffic to trails and roads is considered an open-ride area. Established routes of travel often exist or become developed within open-ride areas, but almost any portion of an open-ride area may become impacted by excessive OHV traffic. Erosion-related impacts on open-ride areas can be minimized if drainage courses are protected and sediment is kept within the open area boundaries. Specific design considerations include:

  - Open-ride areas should be assessed, designed and maintained as an independent facility. The expectation is that some environmental impact will occur from OHV use but that such impacts will not extend beyond the boundaries of the open-ride area.
  - Roads and well-defined trails within an open-ride area should be away from major watercourses.

- Areas that provide habitat for endangered plants and wildlife should be avoided.
- Key monitoring points within the drainage network in an open-ride area should be identified for subsequent monitoring of potential erosion, sedimentation, loss of riparian habitat or other impact.
- An erosion potential assessment should be conducted on an area being considered for open-ride designation. More detailed analysis should be conducted before considering the use of areas with high erosion hazard for open riding activities. If areas of high erosion hazard lie within existing open-ride facilities, analyses should be conducted to assess whether OHV traffic should be limited.
- The potential for erosion from water, wind, and/or mechanical forces should be evaluated throughout the facility so that areas that receive concentrated use within an open-ride area, such as near camping and staging areas, are located away from areas that are more naturally susceptible to erosion.

- Dunes and Desert Sand Environments. Depending on conditions, dunes and desert sand environments can be fragile. Recovery of these environments, if damaged, can be lengthy. Dune environments vary and depend on the type of dunes that have developed, wind patterns that affect dune orientation, vegetation diversity, and hydrological conditions. Wind transport is one of the most important factors in the distribution of natural communities within dune and desert sand environments. Dunes and relatively bare areas within desert environments (i.e., sand drifts, blowouts, and washover fans) should be managed as dynamic (moving) systems. Stabilization measures specific to OHV use should be carefully evaluated prior to implementation so that potential impacts to these mobile systems is minimized. Other design considerations for OHV recreation in dune and desert sand environments are presented below.

    - The location, type and extent of dune ecosystems on which an OHV facility may be located should be known prior to designing the OHV project.
    - Dune morphology (relative relief, orientation, arrangement, and relationship of the dune assemblages to the underlying geologic formations) should be assessed prior to designing the OHV project.
    - Sensitive areas, such as habitat for endangered wildlife and vegetation, and paleontological (fossil) sites, should be delineated, and OHV access to these areas should be restricted.
    - Cultural and natural resources within or adjacent to a dune or desert environment should be identified so that the OHV project can be designed to minimize impacts to the features.
    - Potential impacts of OHV use on the dune and desert sand environments should be assessed.
    - Open-ride area OHV activity may need to be limited in vegetated areas.

- The location and number of parking areas, campsites, and access routes should be minimized to reduce potential impact to the environment. These OHV facility features should be located on naturally flatter areas to minimize grading.

- OHV Hill Climbs. A hill climb in an OHV area is, as it sounds, a trail leading straight up a steep slope. Hill climbs generally have gradients of 50 percent or more. Hill climbs are generally 125 feet or more in length and eight to 20 feet wide. Erosion can occur on hill climbs in areas where soils are poorly consolidated and where exposed bedrock, such as decomposed granite, is friable and erodes easily. Design considerations for hill climbs include the following:

  - Hill climbs should be located on soil or bedrock units that are resistant to erosion.
  - As physical setting allows, no more than two hill climbs should be located for every 100 horizontal feet of slope face.
  - For safety, the approach to a hill climb should be relatively flat, and the "top" of the hill climb should be at least 20 feet below the crest of the slope.
  - To avoid gully erosion, any runoff drainage that originates from areas upslope from the hill climb should be diverted away from the hill climb.
  - Hill climbs should be located such that any runoff drainage that may flow down the hill climb does not flow directly into adjacent watercourses.
  - Topography and other physical conditions should allow for soil that is eroded from a hill climb to deposit on the landscape no more than 500 feet from the base of the hill climb. These eroded materials can be used for hill climb repair, if necessary.
  - The extent of disturbance at any hill climb shall not exceed the capacity of the facility manager to recondition the hill climb.
  - Hill climbs not managed for sustained use should be closed to OHV recreation and rehabilitated.

- OHV Routes for Special Events and Races. The OHV courses for special events and races are designed as either point-to-point routes or closed-loop routes. Competitions include cross-country races, enduros, dual sports, hare-and-hound races, trials riding, rock climbs, obstacle course contests for four-wheel-drive vehicles, and motocross races on closed-loop courses. Some events are timed while others are based on distances traveled and obstacles encountered. Some OHV areas have training facilities for these events which may also be used for the competitions. Other courses are built specifically for an event. Some considerations when designing OHV routes for special events and races include:

  - Facilities should be designed with consideration of prevailing wind direction, sun angles, noise, and anticipated crowds.

- Design facilities to keep displaced soils, erosion and sedimentation on site.
- For cross-country events, designated routes should be marked clearly with barrier tape. Exclusion fencing should be used to protect environmentally sensitive areas. Route markers and fencing should be removed at the conclusion of events.
- After an event, temporary tracks should be regraded to restore natural drainage patterns, and native vegetation should be restored if necessary.

2.6.4. Construction

Appropriate construction procedures and techniques should be employed when constructing an OHV project to ensure that the project is sustainable and minimally impacts the environment. Important elements which should be incorporated in the construction of an OHV project are discussed below.

- Construction Equipment

  - Equipment and machinery should be chosen for trail-specific needs.
  - Bull dozers, loaders, road graders and other heavy machinery intended for large-scale earth-moving are not appropriate for trail construction or maintenance.
  - Specialized earthmoving equipment, scaled for narrow access, is available for OHV trail construction and maintenance projects. A good overview of specialized equipment is presented in Gonzales (1996).
  - For safety purposes and for the integrity of OHV roads and trails, personnel operating machinery should be sufficiently experienced, competent, and, as appropriate, certified in the use of the machinery.
  - Experienced personnel using shovels and other hand tools may be the most appropriate choice for trail construction in some settings.

- Plan Documentation and Construction Control

  - At least one field copy of the plans for the OHV project should be on site and available for reference by the construction crew and others, as needed, during all phases of construction.
  - Sensitive areas, such as habitat for endangered wildlife and vegetation, and paleontological (fossil) sites, should be known and delineated if necessary. OHV access to these areas may need to be limited.
  - Any changes to the original project plans should be documented and noted on the field copy of the plans. The field copy of the plans, with annotations regarding plan changes, will be the primary reference for compiling as-built documentation.
  - As-built documentation for a project, including as-built plans, should prepared and compiled following completion of the project. Reasons for

changes made to the original design should be included in the as-built documentation.
    - For the grading of a new OHV road or trail, the intended alignment of the path should be staked or flagged in the field. The proposed trail grade elevation should also be surveyed and noted with stakes or flagging. If machinery is to be used for path construction, the equipment operator should review the staked or flagged alignment. Discrepancies between the planned path and actual geography can be visualized with the stakes or flagging, and modifications, if any, can be made before grading is underway.
    - Proposed watercourse crossings should also be visualized using stakes or flagging prior to grading and construction. Key elements of a watercourse crossing to stake include path approach to crossing, path width through crossing, path low point, gradient across path at crossing point, foundation locations if planned (i.e., bridge). The need for plan modifications can then be discerned before any materials are disturbed. Modifications should be noted for as-built documentation purposes.
    - Plans and associated documents should be maintained and updated as necessary by the OHV facility manager or designee. This documentation will assist in verifying compliance with the Soil Conservation Standard.

- Compaction of Earth Materials

    - The degree of to which earth materials can be compacted is a function of soil type, soil moisture content, and compaction effort.
    - A natural surface that is to be compacted for construction purposes, and which may receive fill for compaction, must first be prepared prior to fill placement. Preparation, at a minimum, includes removing ground vegetation such as brush and grass and excavating below the roots of such plants. Soil that has abundant vegetative matter mixed with it should not be used as fill.
    - Prior to compaction, the moisture content of the soil should be assessed to determine if the soil moisture is at or near optimum for compaction purposes.
    - Soil will not compact if it is too wet or too dry. An informal method to determine if soil moisture content in a non-rocky soil is near optimum for compaction is to squeeze a handful of the soil. If the handful of soil becomes a clod that holds its shape and can be broken into two halves, moisture content is near optimum for compaction purposes. If the clod crumbles into several pieces, the soil is too dry. If the soil oozes through the fingers, the soil is too wet.
    - Soil moisture should be examined at several locations and depths. Under field conditions, soil moisture will vary by soil type, depth, and location. Slope angle and orientation, elevation, vegetation, shading, and surface drainage also influence soil moisture content.

- Soils that consist of sand, or sand and rock, lack cohesion and so the above soil moisture test is not effective for these materials. Nonetheless, these soils drain well and compact well if used to fill a void, such as a steep-sided excavation.
- Sand and sandy soil with rock should generally not be used for trail tread surfaces because the materials lack cohesion.
- Assuming soil moisture is optimum, the exposed surface to be compacted should be scarified and compacted using appropriate equipment, such as a sheep's foot roller, the tire tread or track of heavy equipment, or vibrating pad backhoe attachment.
- For the placement of compacted fill over a prepared surface, fill soil at or near its optimum moisture content should be spread onto the surface in "lifts" of six to eight inches, and compacted using appropriate equipment as described above.
- Soil in lifts thicker than eight inches may not be compacted throughout the lift thickness. Lifts that are too thick can "bridge," where only the upper portion of the lift compacts. Over time, and with OHV traffic, fill with "bridged" lifts will settle, causing misalignment of the trail and low points, which create chronic drainage problems.
- Soil compaction of each lift can be evaluated qualitatively and quantitatively. Compaction can be measured qualitatively using a soil probe or an L-shaped, two- to three-foot length of quarter-inch diameter steel rebar. The probe tip or rebar end at the top of the "L" is placed on the compacted soil surface. The person inspecting the fill compaction leans heavily on the probe crossbar or on the rebar. If the tip sinks more than 3 to 5 inches the fill should be excavated, moistened as needed, placed as a lift and recompacted.
- Quantitative compaction testing entails first determining the maximum density of the soil that is compacted and then comparing that density with the density of the soil compacted in the field. Quantitative compaction testing of this sort requires use of equipment specified by the American Society of Testing and Materials (ASTM) and is usually performed under the supervision of a qualified engineering geologist or engineer. OHV trail projects in general do not need this level of compaction testing, but site conditions and proposed fill thicknesses may necessitate the supervision of a qualified professional and compaction testing according to ASTM standards.
- Excess soil materials should be hauled to a suitable, stable location that is not directly upslope from a watercourse or other water body.
- Earth materials should not be cast over the downslope side of any trail or road.

2.7. Bibliography

California Department of Parks and Recreation, 1991, Soil Conservation Guidelines/Standards for Off-Highway Vehicle Recreation Management: 78 p.

California Geological Survey, 2006, Index to Geology and Soils in California Off-Highway Vehicle Recreation Management Areas: Prepared for California State Parks Off-Highway Motor Vehicle Recreation.

California State Parks, 2002, Taking the High Road: The Future of California's Off-Highway Vehicle Recreation Program: The Off-Highway Motor Vehicle Recreation Division, Sacramento, California, 98 p.

Chepil, W.S. and Woodruff, N.P., 1959, Estimation of Wind Erodibility of Farm Fields: U.S. Department of Agriculture, Agricultural Research Service, Production Research Report No. 25.

Chepil, W.S., and Woodruff, N. P., 1963, The physics of Wind Erosion and Its Control: Advancements in Agronomy, Vol. 15, p. 211-302.

Conley, Jerry, Vogel, James, and Chilman, Kenneth, 1991, Open Area Management And Monitoring Programs, Tennessee Valley Authority.

Cooper, W.S., 1967, Coastal Dunes of California: Geological Society of America, Memoir 104, 131 p.

Fogg, G.E., 2002, Park Guidelines for Off-Highway Vehicles, A Resource Guide to Assist in the Planning, Development, Enhancement, and Operation of OHV Recreation Facilities: National Off-Highway Vehicle Council, 196 p.

Gonzales, R. H., 1996, Mechanized Trail Equipment, USFS San Dimas Technology & Development Center, Doc No. 6E61A25.

Hagen, L.J., Wagner, L.E., and Tatarko, J., 1996, Wind Erosion Prediction System (WEPS): Natural Resources Conservation Service, Beta Release 95-08, 228 p.

Hamilton, Nora, 1991, Off-Highway Vehicle Maintenance: Tractor Techniques For Trailbed Preservation, USFS, Mendocino National Forest, Tech. pub T-0001.

Hamilton, Nora, 1991, Trail Maintenance – An Outline For Developing A Practical Maintenance Plan, USFS, Mendocino National Forest, Tech. pub T-0011.

Lockwood, C., 1996, Trails 2000 – A Trail Construction And Maintenance Update, USDA Forest Service, Angeles National Forest.

United States Department of Agriculture, Forest Service, 1991, Trails Management Handbook, USFS Handbook 2309.18.
United States Department of Agriculture, Forest Service, 2000, Soil Stabilizers On Universally Accessible Trails, USFS Technology and Development Program pub 0023-1202-SDTDC.

United States Department of Agriculture, Forest Service, 2000, Water Quality Management For Forest System Lands In California – Best Management Practices, Pacific Southwest Region.

United States Department of Agriculture, Forest Service, 2001, A Field Evaluation Of The Use Of Small Trail Tractors To Maintain And Construct OHV Trails On National Forests In California, prepared by R. J. Poff & Associates and Tom Ryan.

United States Department of Agriculture, Forest Service, 2002, Managing Degraded Off-Highway Vehicle Trails In Wet, Unstable, And Sensitive Environments, USFS Technology and Development Program pub 0223-2821-MTDC.

United States Department of Agriculture, Forest Service, 2003, Development Of A Repeatable Regional Protocol For Performance-Best Monitoring Of Forestry Best Management Practices, USFS Northern Research Station, General Technical Report NE-335.

United States Department Of Agriculture, Forest Service, 2003, Forest Service Handbook, Part 2509.18 – Soil Management- Chapter 2 – Soil Quality Monitoring.

United States Department of Agriculture, Forest Service, 2004, Revised OHV Trail Monitoring Form (GYR Form) And Training Guide, prepared by R. J. Poff & Associates.

Vachowski, B., and Maier, N., 1998, Off-Highway Vehicle Trail And Road Grading Equipment, U.S. Department of Agriculture Forest Service Technology & Development Program, Missoula, MT.

Wernex, Joe, 1984, Off-Highway Motorcycle & ATV Trails Guidelines For Design, Construction, Maintenance, And User Satisfaction, pub. American Motorcyclist Association, 2nd ed, 55 pp.

Wischmeier, W. H., and Smith, D.D., 1978, Predicting Rainfall Erosion Losses: Agricultural Handbook No. 537, Agricultural Research Service, Washington D.C.

APPENDIX 1: DEFINITIONS

All Terrain Vehicle (ATV): Any vehicle as defined by California Vehicle Code Section 111.

Beneficial Use: Uses of water as defined by Section 13050(f) of the Water Code and as described in the applicable Water Quality Control Plan. FPRs, 2005, Title 14 CCR 895.1

Best Management Practices (BMPs): Methods, measures, or practices selected by an agency to meet its non-point source control needs. BMPs include but are not limited to structural and nonstructural controls and operation and maintenance procedures. BMPs can be applied before, during, or after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. Ruffolo, 1999, California Research Bureau, California State Library

Buffer: Land or physical barriers acquired or established contiguous to, or in the vicinity of, existing or proposed off-highway motor vehicle recreational activities to protect plant and wildlife habitat, soils, view sheds, or reduce noise and other effects on development in the surrounding areas for the purpose of sustaining off-highway motor vehicle recreation use.

CEQA: California Environmental Quality Act, Public Resources Code (PRC) Section 21000 et seq.; Title 14, California Code of Regulations (CCR) Article 20. CCR 4970, 2008, OHV Grants and Cooperative Agreements Program Regulations

Conservation: Activities, practices, and programs that sustain soil, plants, wildlife and their habitat, and natural and cultural resources as referenced in PRC Sections 5090.10, 5090.35, and 5090.50.

Construction: The act of building or assembling using different parts, materials, or elements in an ordered manner including, but not limited to physical barriers, trail building, roads, facilities, hardening of stream crossings, fencing, sediment control structures, and facilities landscaping.

Cultural Resources: Resources associated with events that have made a significant contribution to the broad patterns of California's history and cultural heritage; are associated with the lives of persons important in our past; embodies the distinctive characteristics of a type, period, region, or method of construction, or represents the work of an important creative individual, or possesses high artistic values; or has yielded, or may be likely to yield, information important in prehistory or history. Cultural resources also include Historical Resources. A resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the California Register of Historical Resources. PRC Section 5024.1, Title 14 CCR, Section 4852

Erosion: The wearing away of rock or soil by the detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces. CARC 2006

Erosion Controls: Drainage facilities, soil stabilization treatments, road and landing (parking) area abandonment, removal and treatment of watercourse crossings, and any other features or actions to reduce surface erosion, gullying, channel erosion and mass erosion. FPRs, 2005, CCR 895.1 Definitions

Facility: An OHV trail, track, road, corridor, SVRA, open-ride area, staging area, parking area (excluding structures). CARC 2006

Grant: An award of funding to a local agency, educational institution or nonprofit organization.

Gully: An erosion channel cut into the soil along a line of water flow with a minimum depth of 6 inches and cross-sectional area of one square foot. Schwab et al, 1993, Soil and Water Engineering USDA, 1993, Soil Survey Manual; USDA, 1993, Soil Survey Manual; and CDF Hillslope Monitoring Study

Gully Erosion: Erosion of soil or soft rock materials by running water that forms distinct channels generally greater than 6 inches deep and that usually carry water only during and immediately after heavy rains or following the melting of ice or snow. Modified from American Geological Institute, Glossary of Geology and CDF Hillslope Monitoring Study

Long-Term: At a minimum, 25 years.

Maintenance: The work required to ensure effective and efficient use of physical facilities, OHV recreational opportunities, and the protection of natural and cultural resources.

Management: The coordinated implementation of budgeting, staffing, scheduling, design, construction, maintenance, monitoring and restoration activities at an OHV facility, as needed, combined with the effective utilization and coordination of resources, such as capital, labor, materials, and the natural landscape, to achieve the soil conservation standard, and to ensure effective and efficient use of OHV recreational opportunities while protecting natural and cultural resources. Modified from CARC 2006

Marsh: Flat, wet, treeless areas usually covered by standing water and supporting grasses and grass-like plants. 1991 Soil Guidelines

Monitoring: Data collection used by a land management agency and/or the Division to make appropriate decisions.

NEPA: National Environmental Policy Act pursuant to United States Code (U.S.C.) Title 42, Section 4371; 40 Code of Federal Regulations (CFR) part 1500.1 et seq. CCR 4970, 2008, OHV Grants and Cooperative Agreements Program Regulations

Off-Highway Vehicle: An off highway motor vehicle as specified in CVC Section 38006 and street licensed motor vehicles while being used off-highway.

Off-Site: Beyond the borders of the designated off-highway vehicle area. Off-site need not mean transport onto land under a different ownership. 1991 Soil Guidelines

Open Area or Open Ride Area: An expansive area used by off-highway vehicles, where vehicle use is not limited to designated roads or trails. Established routes of travel often exist or become established in Open Ride areas, but almost any portion of the site may become impacted by off-highway vehicles at any time. 1991 Soil Guidelines

Project: Work to be accomplished, either proposed or approved, with funding through an OHV grant or cooperative agreement.

Public Lands: Federal, state, county or city-owned or administered lands. 1991 Soil Guidelines

Recondition: To return a site to a functional condition. Modified from Webster's 10th Edition Dictionary

Repair: To fix, mend, make new, or revitalize to sound condition after being damaged.

Restoration: Upon closure of an OHV unit or any portion thereof, the restoration of land to the contours, the plant communities, and plant covers comparable to those on surrounding lands, or at least those that existed prior to off-highway motor vehicle use. PRC Section 5090.11

Rill: An erosion channel cut into the soil along a line of water flow greater than 1 inch and less than 6 inches deep. CDF Hillslope Monitoring Program

Rill Erosion: The development of numerous closely spaced channels generally less than 6 inches deep that result from the uneven removal of surface soil by running water that is concentrated in streamlets of sufficient volume to generate cutting power. Modified from Glossary of Geology and CDF Hillslope Monitoring Study

Riparian Area: The banks and other adjacent terrestrial environs of lakes, watercourses, estuaries, and wet areas, where transported surface and subsurface freshwaters provide soil moisture to support mesic vegetation. FPRs, 2005, 895.1

Roads: Logging roads, service roads, and other roughly graded roads upon which vehicular travel is permitted (CVC 38000).

Route: A road, trail, course, or way for travel from one place to another. The American Heritage Dictionary of the English Language, fourth Edition

Sedimentation: The process by which soils, debris and other materials are deposited, either on land or in water. CARC 2006

Significant: Having a substantial or potentially substantial effect. CARC 2006

Snowmobile: Any vehicle as defined in CVC 557.

Soil: All unconsolidated materials above bedrock; the unconsolidated mineral or organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants; the unconsolidated mineral or organic matter on the surface of the earth that has been subjected to and shows effects of genetic and environmental factors of climate (including water and temperature effects), and macro-and microorganisms, conditioned by relief, acting upon parent material over time. Soil differs from the material from which it is derived in many physical, chemical, biological and morphological properties and characteristics. American Geological Institute, Glossary of Geology, 1997

Soil Erosion: Detachment and movement of topsoil, or soil material from the upper part of the profile, by the action of wind or running water, or as a result of changes brought about by human activity. It includes: rill erosion, gully erosion, sheet erosion and wind erosion. American Geological Institute, Glossary of Geology, 1997

Soil Loss: Movement of soil material to a location where the soil cannot be reasonably retrieved and/or recycled. CARC 2006

Staging/Parking/Camping Areas: These areas include all sites (designated and undesignated) that are used for these activities. Staging areas commonly include areas to unload off-highway vehicles from trucks or trailers and areas to fuel, maintain, and wash the vehicles during and after use. This includes areas in the vicinity of restrooms and bulletin boards. 1991 Soil Guidelines

Standard: Any definite rule, principle, or measure established by authority. Something established by authority, custom, or general consent as a model or example (criterion); something set up and established by authority as a rule for the measure of quantity, weight, extent, value or quality. Webster's 9th New Collegiate Dictionary

Stream: A natural watercourse as designated by a solid line or dash and three dots symbol shown on the largest scale United States Geological Survey map most recently published. FPRs, 2005, PRC section 4528 (f)

Sustainability: Managing soil and crop cultural practices so as not to degrade or impair environmental quality on or off-site, and without eventually reducing yield potential as a result of the chosen practice through exhaustion of either on-site resources or nonrenewable inputs. American Geological Institute, Glossary of Geology, 1997

Sustainable: The facility is managed to meet the soil conservation standard for a minimum service life of 25 years as defined by CCR 4970. CARC 2006

Track: A facility designed and constructed for confined use of races and practice riding. 1991 Soil Guidelines

Trail: Any route that is not designated as a road. 1991 Soil Guidelines

Volunteer Trail: A trail that was formed by the passage of vehicles and not built by earth moving machines or hand tools. California State Parks

Watercourse: Any well-defined channel with distinguishable bed and bank showing evidence of having contained flowing water indicated by deposit of rock, sand, gravel, or soil, including but not limited to, streams as defined in PRC 4528 (f). FPRs, 2005, Title 14 CCR 895.1 Definitions

APPENDIX 2: TRAIL CONDITION EVALUATION

Abbreviated Instructions for OHV Trail Condition Evaluation Form

I. Form Header Information

Trail Name / No.
Enter name and/or number of the trail for the rated segment.

Vehicle Type
Circle one or more of the vehicle types, MC (motorcycle), ATV (all-terrain vehicle), or 4x4 (four wheel drive), or SM (snow mobile).

Trail Difficulty
Circle one of the trail difficulties, easiest, more difficult, most difficult.

USGS Quad
Enter the name of the USGS topographic map quadrangle on which the rated segment occurs.

Planning Watershed
Enter in either the name or the code for the CalWater (2.2) planning watershed in which the trail occurs (http://www.ca.nrcs.usda.gov/features/calwater/).

Begin Segment
Enter the location where the rated segment starts. This could be a GPS file designation, a named trail junction, a milepost, etc.

End Segment
Enter the location where the rated segment ends. This could be a GPS file designation, a named trail junction, a milepost, etc.

Site Characteristics
Give a generic description of the site and soil-related conditions that exist along the trail.

Soil/Geology
Enter a brief description of the soil and/or geologic units on which the trail segment is located. Information can be provided from field observations by a qualified soil scientist or geologist, or it may be obtained from NRCS or USFS soils maps, geological publications listed in the California Geological Survey (CGS) geology/soils index and website, and other published and unpublished reports including various planning documents.

Vegetation
Enter a brief description of the primary vegetation present in the vicinity of the trail.

Range of Side Slopes
Circle the range of side slope percent (%) that the segment of trail crosses.

Trail Slope
Enter the average trail slope and the maximum trail slope in percent (%) for the segment evaluated.

Rating (GYR)
As the final step in completing the form, enter the recommended overall rating for the whole segment. Enter only *one* letter for the rating: a G, Y, or R.

GPS Ref
Enter the file name of the GPS record. Add location information following post-processing of the GPS record.

Rated By
Enter your name or initials as the rater.

Date
Enter the date the field observations were made and recorded.

Reviewed By
Signature of responsible official who reviewed and acted on the rating.

Date
Date reviewed by responsible official.

Page __ of __
Enter page number and total number of pages used to rate the segment.

II. Form Body Information

Column 1 – Section; Begin – End
For features with a length dimension, enter the beginning and ending distance of that feature, e.g. 1200 feet to 1500 feet for a 300-foot feature. Distance can either be from an established reference point such as a trail marker (mile post) or intersection, or the GPS file designation for the beginning and ending points.

Column 2 - Section Length
Enter the length of the section being evaluated and note whether it is an estimate or has been measured.

Column 3 - Trail Slope
Enter the slope (grade) of the tread surface for the section evaluated as a percent (%) If the slope varies, enter the range followed by the slope most typical for the section in parentheses, e.g. 3 – 25% (6%).

Column 4 - Crossings
Facing downstream, every crossing has three primary components: the left approach (LA), the right approach (RA) and the channel section (CS). Enter a checkmark (√ or X) in the column corresponding to the part of the crossing being evaluated, e.g. LA for left approach. Rate each component on a separate line. Rate each approach according to G7, Y7, or R7. Rate each channel section according to G8, Y8, or R8. Record the condition of all watercourse approaches even if the rating is a G7. This serves as documentation that the approach was evaluated.

	Approach Length (from last water break or drainage divide to channel)		
Trail Gradient	< 30 feet	30 – 150 feet	> 150 feet
< 8 %	G7	G7	Y7
8 – 20%	G7 or Y7	Y7 or R7	R7
> 20%	Y7 or R7	R7	R7

Guidelines for Rating Approaches to Watercourse Crossings

The key concept is sediment delivery. Where runoff water from a trail is drained onto a natural slope a long distance from a watercourse, most sediment is filtered out before it can reach a watercourse.

Column 5 - GYR Condition Codes
Enter the appropriate condition code using the Green, Yellow, Red indicators of trail conditions listed as guidelines. More detailed descriptions are presented in the expanded 2008 Soil Conservation Guidelines/Standards for OHV Recreation Management. Where variable conditions are encountered, the rater will have to use good judgment using the condition codes as an overall guide. Additional details can be written in the comments section of the form.

Column 6 - Cause Codes
Using the cause codes provided as guidelines, enter a cause code for each trail section where a condition code was entered in Column 5. More detailed cause code descriptions are presented in the expanded 2008 Guidelines/Standards. Most trail condition problems have multiple causes. Generally, one to three causes, listed in order of importance, will be enough to describe the problem. If the cause of an observed condition is unique, then describe that cause in the comments column. A cause code combined with a GYR condition code will usually both describe the problem and identify a treatment.

Column 7 – Comments
Record observations and recommendations not captured by the basic codes, including unique non-repeatable data.

Column 8 – Photograph Number (s)
Enter the identification number(s) for photographs taken of the evaluated section. As a minimum, one photo should be taken for each section given a Red condition code. If the entire trail segment has been rated Green, take at least one photograph of a representative section of the trail segment.

OHV Trail Condition Evaluation Form

Trail Name ________________________________Trail No. ________________ Vehicle Type: MC ATV 4x4 SM Trail Difficulty: easiest, more difficult, most difficult

USGS Quad _____________________ Planning Watershed ___________________________ Begin Segment _________________ End Segment ____________________

Site Characteristics: Soil/Geology ____ Vegetation _____________________________ Side Slopes: 0-30% 30-50% >50%

RATING (**G**,**Y**,**R**) _____GPS Ref _________________ Avg Trail Slope ___% Max Trail Slope ____% Rated By _____ Date _____ Reviewed By ____ Date _____ Page __ of __

Section B = Begin E = End	Section Length	Trail slope	Crossings LA	CS	RA	Condition Codes	Cause Codes	Comments	Photograph Numbers
B E									
B E									
B E									
B E									
B E									
B E									
B E									
B E									
B E									
B E									

OHV Trail Condition Evaluation Code Key

	Green		Yellow		Red
G1	**Water control** is provided by enough functional water breaks to divert runoff from the trail before it has the volume and velocity to cause erosion. Where present, rills occur on less than 1/3 of the distance between water breaks.	Y1	Water breaks do not divert all runoff from the trail because they are nearly filled to capacity and/or are partially breached, or spaced too widely. Where present, rills occur on more than 1/3 of the distance between water breaks	R1	Water breaks no longer divert runoff from the trail because they are full and/or have been breached, or are absent or spaced too widely. Gully or rill erosion may be present.
G2	No accelerated **erosion off-trail.** Runoff at water break outlets and on slopes adjacent to the trail is dispersed effectively. Vegetation or litter filters all sediment.	Y2	Rill erosion and/or sediment deposition occurs at water break outlets and/or on slopes adjacent to the trail. All sediment is filtered or deposited before it reaches a watercourse.	R2	Gully erosion occurs at water break outlets or on slopes adjacent to the trail and/or sediment is transported to a Type I or Type II watercourse.
G3	**Sediment traps**, where present, are functional and have adequate capacity for at least one season of use. Trapped sediment can be retrieved during normal maintenance.	Y3	Where present, most sediment traps are full or nearly full, but still functional. Most trapped sediment can be retrieved during normal maintenance.	R3	Where present, sediment traps have been breached and have a plume of sediment and/or a gully below the breach. Most sediment cannot be retrieved.
G4	**Tread wear** is minimal. Tread is generally incised less than 6 inches. Tread wear is generally evident on less than 1/3 of the distance between water breaks or on less than 1/3 of the tread width.	Y4	Tread wear is evident. Tread is generally incised 6 to 12 inches and tread wear is generally evident on more than 1/3 the distance between water breaks and on more than 1/3 of the tread width.	R4	Tread wear is severe. Tread incision is generally greater than 12 inches deep and tread wear is generally evident on the entire distance between water breaks.
G5	**Tread width** is generally no greater than 1.5 times the design width for the designated use.	Y5	Tread width is generally greater than 2 times the design width for the designated use and appears to be increasing.	R5	Tread width is generally greater than 3 times the design width for the designated use and has caused or is causing erosion, sedimentation, and damage to vegetation.
G6	**Off-trail travel is** limited to single tracks or single passes generally less than 300 feet long. Tracks are not eroded and have little effect on water control.	Y6	Off-trail travel is common, well defined, and generally greater than 300 feet long. Water control is inadequate and some erosion is apparent.	R6	Off-trail travel has caused severe resource damage, gully erosion, eroded hill climbs, or extensive damage to vegetation and/or sensitive habitat.
G7	**Approach to watercourse crossing** is short and has a gentle gradient. Tread is stable, shows little evidence of erosion, and is at design width. No damage to riparian vegetation outside the tread.	Y7	Approach to watercourse crossing is short and steep or long and gentle. Tread may show some evidence of erosion and may show evidence of widening. Minimal damage to riparian vegetation.	R7	Approach to watercourse crossing is both steep and long and/or tread is unstable and shows evidence of accelerated erosion. Approach may be widening and damaging riparian vegetation.
G8	**Channel Section** has only minor channel widening, minor bank erosion, no bars.	Y8	Channel Section has widened moderately, modest bank erosion, modest lateral and/or mid-channel bars.	R8	Channel Section has widened significantly, extensive bank erosion, large lateral and mid-channel bars.
G9	**Outboard Fill** is stable. Exhibits minor surficial sloughing without sediment transport	Y9	Outboard Fill is distressed. Exhibits cracking and Moderate sloughing w/ limited sediment transport.	R9	Outboard Fill has failed and sediment is moving down slope.

	CAUSE CODES		CAUSE CODES
C1	Water breaks not constructed to design standards	**C11**	Rocks or roots exposed in tread
C2	Water break spacing is too wide for conditions	**C12**	Barriers (natural or constructed) to control traffic are lacking
C3	Cascading runoff from a trail or road upslope	**C13**	Mechanical erosion makes maintenance ineffective
C4	Cascading runoff from an impervious surface upslope	**C14**	Storm intensity unusual or unique for the area
C5	Wet area caused by a seep or spring	**C15**	Design / layout /construction prevents effective drainage
C6	Excess soil moisture at time of use	**C16**	Uncompacted sidecast on outboard slope
C7	Trail section is poorly located (describe)	**C17**	Berms, Whoops, and stutter bumps
C8	Trail gradient is too steep for the type and/or amount of use occurring	**C18**	Crossing alters channel dimensions and/or stream gradient.
C9	Segment is not ~~designated or~~ designed for the type or amount of use occurring	**C19**	Rutting or vegetation damage to meadow, spring, wet area, riparian area
C10	Trail Blockage, e.g. brush, logs, rockfall, landslide	**C20**	Segment is not designed for the type and amount of use occurring

APPENDIX 3: MAINTENANCE AND EVALUATION OF TRAIL CONDITIONS

Mechanized Construction - Maintenance Checklist

Trail Name ________________Trail No.____________ Segment No. _______________

Trail Difficulty easiest more difficult most difficult Max Trail Slope ___% Ave Trail Slope ___%

Activity: maintenance reconditioning new construction Side Slope:____%
Drainage: Outslope Rolling Dip Confined Flat Other_______
Equipment: Hand Trail Tractor Mini-excavator Other__________
Soil Type: clayey loamy sandy Rock Fragments (%): <15 15-50 >50
Soil Depth: shallow deep Vegetation Type: ________ Photo Numbers: _____________
Operator _____________________ Assistant(s) _______________Date _________
Last Maintenance (mo/yr) ______ Maintenance Type : Hand Mechanical
Notes:____

Guideline	Yes	No	N/A
1. This checklist was reviewed before starting maintenance or construction on this trail	☐	☐	☐
2. Prior to mobilization the completed OHV Trail Condition Evaluation Forms were reviewed and trail segments, sections, or features needing maintenance or reconditioning were confirmed.	☐	☐	☐
3. Equipment was operated by certified operators, or under direct supervision of certified operator	☐	☐	☐
4. If new, this trail was constructed to Guidelines	☐	☐	☐
5. OHV rolling dips were constructed/maintained by compacting moist soil in lifts no greater than 4 inches loose thickness	☐	☐	☐
6. Prior to mobilization, need for maintenance with mechanical equipment was validated	☐	☐	☐
7. The blade was lifted and the equipment walked across sections of trail that needed no maintenance	☐	☐	☐
8. Soil collected in rolling dip outlets was recycled into rolling dip structures or back onto the trail tread	☐	☐	☐
9. Berms were worked back into the trail tread, not bladed off the trail as sidecast	☐	☐	☐
10. Rills and gullies in treads were repaired with soil reclaimed from rolling dip outlets or from outside berms, not by blading the trail tread	☐	☐	☐
11. Soil sloughed from cutbanks or sideslopes above the trail was bladed only as needed to maintain a safe trail; cutbanks were not bladed into or undercut	☐	☐	☐
12. Whoops and stutter (braking) bumps were repaired by ripping, blading, and compacting trail treads when soil was moist (except for non-cohesive soils)	☐	☐	☐
13. The amount of soil moved was the smallest amount needed to meet the maintenance objective	☐	☐	☐
14. Where soil was too dry for compaction, maintenance was deferred or done by hand	☐	☐	☐

If "no" is checked, enter a footnote number and write a brief explanation under comments.
Comments: ____
____
____