Water Resource Protection Plan

WDID: 1B171560CHUM

APN(s): 216-013-011; 216-012-007 (Humboldt)

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Humboldt County
Planning Division

Prepared by:

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2/5/2018

Revised: 11/26/2018

Purpose

This Water Resource Protection Plan (WRPP) has been prepared on behalf of the property owner for the Humboldt county property identified as parcel numbers 216-013-011; 216-012-007 by agreement and in response to the California Water Code Section 13260(a), which requires that any person discharging waste or proposing to discharge waste within any region that could affect the quality of the waters of the state, other than into a community sewer system, shall file with the appropriate regional water board a Report of Waste Discharge (ROWD) containing such information and data as may be required by the Regional Water Board. The Regional Water Board may waive the requirements of Water Code section 13260 for specific types of discharges if the waiver is consistent with the Basin Plan and in the public interest. Any waiver is conditional and may be terminated at any time. A waiver should include monitoring requirements to verify the adequacy and effectiveness of the waiver's conditions. Order R1-2015-0023 conditionally waives the requirement to file a ROWD for discharges and associated activities described in finding 4.

Scope of Report

Order No. R1-2015-0023 states that "Tier 2 Dischargers and Tier 3 Dischargers who intend to cultivate cannabis before, during, or following site cleanup activities shall develop and implement a water resource protection plan that contains the elements listed and addressed below. Dischargers must keep this plan on site, and produce it upon request by Regional Water Board staff. Management practices shall be properly designed and installed, and assessed periodically for effectiveness. If a management measure is found to be ineffective, the plan must be adapted and implemented to incorporate new or additional management practices to meet standard conditions. Dischargers shall certify annually to the Regional Water Board individually or through an approved third-party program that the plan is being implemented and is effectively protecting water quality, and report on progress in implementing site improvements intended to bring the site into compliance with all conditions of this Order.

Methods

The methods used to develop this WRPP include both field and office components. The office component consisted of aerial photography review and interpretation, existing USGS quad map review, GIS mapping of field data, review of on-site photography points, streamflow calculations, and general planning. The field component included identifying and accurately mapping all watercourses, wet areas, and wetlands located downstream of the cultivation areas, associated facilities, and all appurtenant roads accessing such areas. An accurate location of the Waters of the State is necessary to make an assessment of whether potential and existing erosion sites/pollution sites have the potential to discharge waste to an area that could affect waters of the State (including groundwater). Next, all cultivation areas, associated facilities, and all appurtenant roads accessing such areas were assessed for discharges and related controllable water quality factors from the activities listed in Order R1-2015-0023, Finding 4a-j. The field assessment also included an evaluation and determination of compliance with the Standard Conditions per Provision I.B of Order No. R1-2015-0023. The water resource protection plans required under Tier 2 are meant to describe the specific measures a discharger implements to achieve compliance with standard conditions. Therefore, all required components of the water resource protection plan per Provision I.B of Order No. R1-2015-0023 were physically inspected and evaluated. A comprehensive summary of each Standard Condition as it relates to the subject property is appended.

Property Description

The property assessed consists of two 80-acre parcels, located in Section 14 and 15, T5S, R4E, Humboldt Base & Meridian, Humboldt County, from the Harris 7.5' USGS Quad Map. The property is located approximately 5 miles southeast of Benbow, California, and is accessed by Reed Mountain Road. The property has a southeast facing aspect with an elevation range of approximately 720' to 1,400' above sea level. The project area contains un-named tributaries to the East Branch South Fork Eel River.

Project Description

There are currently four actively used Cultivation Areas (CA), (CA A, B, C, & D) located on the property and three abandoned and relocated cultivation areas (CA E, F, & G). Cultivation Area A is approximately 3,600 ft^2 and consists of potted plants within a greenhouse. Cultivation Area B is approximately 4,200 ft^2 and consists of potted plants within a greenhouse. Cultivation Area C is approximately 5,250 ft^2 and consists of potted plants within a greenhouse. Cultivation Area D is approximately 10,800 ft^2 and consists of plants in raised beds. Cultivation Area E is approximately 18,000 ft^2 and consists of potted plants spread out through native vegetation. Cultivation Area F is approximately 14,500 ft^2 and consists of potted plants spread out through native vegetation. Cultivation Area G is approximately 3,000 ft^2 and consist of potted plants on savanna grassland. All water used for irrigation and domestic uses is derived from three surface water diversions located on the property. A Lake and Streambed Alteration Agreement (LSAA/1600) agreement with California Department of Fish & Wildlife (CDFW) has been filed as of the writing of this assessment.

Monitoring Plan

Tier 2 Dischargers shall include a monitoring element in the water resource protection plan that at a minimum provides for periodic inspection of the site, checklist to confirm placement and efficacy of management measures, and document progress on any plan elements subject to a time schedule. Tier 2 Dischargers shall submit an annual report (Appendix C) by March 31 of each year that documents implementation and effectiveness of management measures during the previous year. Tier 2 annual reporting is a function that may be provided through an approved third-party program.

Monitoring of the site includes visual inspection and photographic documentation of each feature of interest listed on the site map, with new photographic documentation recorded with any notable changes to the feature of interest. At a minimum, all site features must be monitored annually, to provide the basis for completion of the annual re-certification process. Additionally, sites shall be monitored at the following times to ensure timely identification of changed site conditions and to determine whether implementation of additional management measures is necessary to iteratively prevent, minimize, and mitigate discharges of waste to surface water: 1) just prior to October 15 to evaluate site preparedness for storm events and storm water runoff, 2) following the accumulation of 3" total precipitation or by November 15, whichever is sooner, and 3) following any rainfall event with an intensity of 3" precipitation in 24 hours. Precipitation data can be obtained from the National Weather Service Forecast Office (e.g. by entering the zip code of the parcel location at http://www.srh.noaa.gov/forecast).

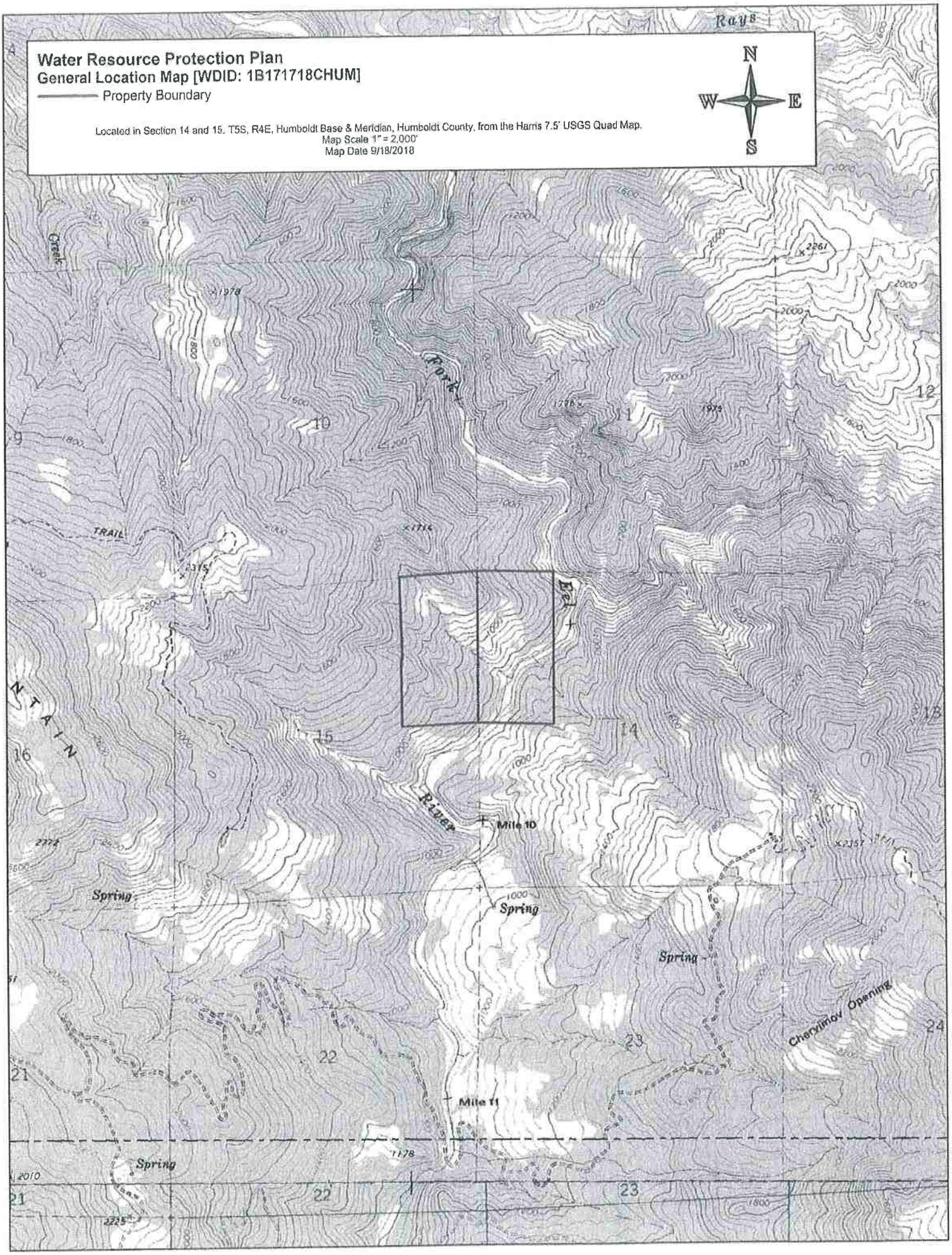
Monitoring Plan Reporting Requirements

Order No. R1-2015-0023, Appendix C must be submitted to the Regional Water Board or approved third party program upon initial enrollment in the Order (NOI) and annually thereafter by March 31. Forms submitted to the Regional Water Board shall be submitted electronically to northcoast@waterboards.ca.gov. If electronic submission is infeasible, hard copies can be submitted to: North Coast Regional Water Quality Control Board, 5550 Skylane Boulevard, Suite A, Santa Rosa, CA 95403.

Water Resource Protection Plan
General Location Map [WDID: 1B171718CHUM]

Property Boundary

Located in Section 14 and 15, T5S, R4E, Humboldt Base & Meridian, Humboldt County, from the Harris 7.5' USGS Quad Map.
Map Scale 1" = 2,000'
Map Date 9/18/2018



Assessment of the Standard Conditions

Assessment of Standard Conditions consisted of field examinations in the summer and fall of 2018. The examination evaluated areas near, and areas with the potential to directly impact, watercourses for sensitive conditions including, but not limited to, existing and proposed roads, skid trails and landings, unstable and erodible watercourse banks, unstable upslope areas, debris, jam potential, inadequate flow capacity, changeable channels, overflow channels, flood prone areas, and riparian zones. Field examinations also evaluated all roads and trails on the property, developed areas, cultivation sites, and any structures and facilities appurtenant to cultivation on the property. Anywhere the Standard Conditions are not met on the property, descriptions of the assessments and the prescribed treatments are outlined following each associated section below.

Summary of Standard Conditions Compliance

1. Site Maintenance, Erosion Control, and Drainage Features Y☐/N☒
2. Stream Crossing Maintenance Y☐/N☒
3. Riparian and Wetland Protection and Management Y☐/N☒
4. Spoils Management Y☒/N☐
5. Water Storage and Use Y☐/N☒
6. Irrigation Runoff Y☒/N☐
7. Fertilizers and Soil Amendments Y☒/N☐
8. Pesticides and Herbicides Y☒/N☐
9. Petroleum Products and other Chemicals Y☒/N☐
10. Cultivation-Related Wastes Y☒/N☐
11. Refuse and Human Waste Y☒/N☐

1. Site Maintenance, Erosion Control, and Drainage Features

Roads are being classified as "permanent" (being used year-round), "seasonal" (being used primarily during summer months), and "trail" (being rarely used for occasional access to features on the property).

Permanent roads consist of a main access road to the residence, structures, water infrastructure, and Cultivation Area A. Permanent roads are adequately surfaced on the majority of the property with native and imported rock surfacing, and are in acceptable condition. However, one segment of permanent road (Site 04 to Site 05) lacks adequate rock surfacing and signs of concentrated surface runoff were observed in several locations on permanent roads (Sites 02, 11, 12, 13, & 14). Seasonal roads consist of access roads to cultivation areas, water infrastructure, and other unused structures on the property. Seasonal roads are adequately surfaced on the majority of the property. However, three areas of seasonal road lack adequate surfacing (Sites 05 to Site 10 and Sites 18 & 21). Further details may be found in the Mitigation Report to follow.

Summary of Standard Conditions Compliance (Cont.)

At least one unstable area was observed on the property. This feature appears to be associated with a large, deep-seated, earth flow feature. This has been mapped as an unstable area on the site map. There was no evidence that cultivation related activities where adversely effecting the landslide, nor where any unstable indicators observed near active cultivation areas.

During inspection of the roads, cultivation areas, and watercourses, nine sites were identified where road surface runoff was not being adequately dispersed or drained, and erosion of the road surface was occurring. These sites require the installation or maintenance of surface drainage features and rock surfacing. Further details may be found in the Mitigation Report to follow.

Cultivation Area A is located on a graded flat with slopes of less than 5% and adjoining natural hillslopes of approximately 35%. Surrounding the cultivation area is timberland and grassland savanna with the nearest surface waters being a Class III watercourse approximately 95 feet to the south. No drainage or erosion issues were observed with the cultivation area or the graded flat on which it is located.

Cultivation Area B is located on a graded flat with slopes of less than 5% and adjoining natural hillslopes of approximately 28%. Surrounding the cultivation area is timberland and grassland savanna with the nearest surface waters being a Class II watercourse approximately 80 feet upslope to the west and approximately 130 feet downslope to the southwest. No drainage or erosion issues were observed with the cultivation area or the graded flat on which it is located. No issues were observed with the cultivation area being within 100 feet of the Class II watercourse. The watercourse is located approximately 80 feet upslope, on the other side of an abrupt bank and hillside, of the cultivation area. On the downslope side of the cultivation area to the southwest, where surface runoff from the cultivation area can affect the watercourse, the watercourse is located approximately 130 feet away; outside of the riparian buffer area.

Cultivation Area C is located on two separate, terraced, graded flats with slopes of less than 5% and adjoining natural hillslopes of approximately 45%. Surrounding the cultivation area timberland and grassland savanna with nearest surface waters being over 200 feet away. No drainage or erosion issues were observed within the cultivation area or the graded flat on which it is located.

Cultivation Area D is located on a graded flat with slopes of less than 5% and adjoining natural hillslopes of approximately 30 to 40%. Surrounding the cultivation area is timberland with the nearest surface waters being over 200 feet away. No drainage or erosion issues were observed within the cultivation area or the graded flat on which it is located.

Cultivation Area E is no longer used and has been relocated to Cultivation Areas A, B, C, & D. The cultivation area is located on a hillside with slopes of approximately 30 to 50%. Surrounding the cultivation area, and within the cultivation area, is timberland with the nearest surface waters being a Class III watercourse to the east approximately 30 feet away. No erosion issues were observed; however, drainage

Summary of Standard Conditions Compliance (Cont.)

issues were observed within the cultivation area. The cultivation area is located on steep slopes above and along a Class III watercourse, and the watercourse's riparian buffer, where surface runoff from the cultivation area can enter the watercourse. This cultivation area is also very difficult to access and must be accessed by footpath only. At the time of this assessment the discharger has relocated this cultivation area to an environmentally superior location at Cultivation Areas A, B, C, & D.

Cultivation Area F is no longer used and has been relocated to Cultivation Areas A, B, C, & D. The cultivation area is located on a hillside with slopes of approximately 25 to 30%. Surrounding the cultivation area, and within the cultivation area, is timberland with the nearest surface waters being a Class III watercourse running through the cultivation area and with the head of a Class III watercourse to the west approximately 20 feet away. No erosion issues were observed; however, drainage issues were observed within the cultivation area. The cultivation area is located on and along a Class III watercourse, with the entire cultivation area being within two Class III watercourse riparian buffers, were surface runoff from the cultivation area is entering the watercourse. This cultivation area is also very difficult to access and must be accessed by footpath only. At the time of this assessment the discharger has relocated this cultivation area to an environmentally superior location at Cultivation Areas A, B, C, & D.

Cultivation Area G is no longer used and has been relocated to Cultivation Areas A, B, C, & D. The cultivation area is located on a natural bench with slopes of approximately 5 to 10% and natural adjoining hillslopes of approximately 30%. Surrounding the cultivation area is grassland savanna and timberland with the nearest surface waters being a Class III watercourse 15 feet approximately feet away to the northeast. No drainage or erosion issues were observed within the cultivation area or the graded flat on which it is located. However, the cultivation area is located within the 50-foot riparian buffer area of a Class III watercourse. This cultivation area is also very difficult to access and must be accessed by a steep footpath/ATV only trail. At the time of this assessment the discharger has relocated this cultivation area to an environmentally superior location at Cultivation Areas A, B, C, & D.

2. Stream Crossing Maintenance

There are four stream crossings located on the property. Two of the crossings have existing drainage structures, one crossing has a drainage facility, and the last has a wooden footbridge with a post and pier foundation within the watercourse. Both of the watercourse crossings (Site 08 and Site 15) are undersized. Site 08's culvert diameter is undersized by 6 inches, one culvert size, while Site 15's culvert diameter is undersized by 12 inches, two culvert sizes. This assessment will not require upgrading of Site 08 and 15's existing structures as both are installed recently, correctly, are functioning properly, and are not undersized severely. The drainage structure at Site 15 requires rock armoring of the inlet and this assessment will require the inlet to be rock armored to mitigate the culvert being undersized. The wooden bridge crossing at Site 03 is in an adequate condition but requires further assessment from CDFW. The drainage facility (dirt ford at Site 07) will be required to be upgraded to a rocked ford. Further details can be found in the Mitigation Report to follow.

A Lake and Streambed Alteration Agreement (LSAA/1600) with California Department of Fish & Wildlife (CDFW) has been filed as of the writing of this assessment. Any additional guidelines, treatments, or restrictions set forth under the finalized Lake and Stream Agreement shall be followed.

Summary of Standard Conditions Compliance (Cont.)

ID#	Runoff Coef. (K)	Altitude Index (1000's ft.)	Time of Concen. (min)	24-hr. Rainfall Intensity (in/hr)	Mean Annual Rainfall (in)	Drainage Area (ac)	Selected Discharge Method	Q 100 RATIONAL (cfs)	Q 100 USGS MF (cfs)
8	0.35	0.0	0	4.39	40	4	RATIONAL	7	5
15	0.35	0.0	6	4.39	40	39	USGS MF	60	33

ID#	Existing Culvert (D) Diameter (in)	Headwall (HW) Height (in)	HW/D (ratio)	Selected Discharge Method	Q100 (cfs)	Culvert Capacity (cfs)	Culvert is Undersized	Recommended Culvert Dia. (in)	Recommendation Based On
8	18	0	0.0	RATIONAL	7	6	TRUE	24	Q100
15	36	0	0.0	USGS MF	33	32	TRUE	48	Q100

3. Riparian and Wetland Protection and Management

Assessment of the property concluded that active cultivation areas, besides abandoned and relocated Cultivation Areas E, F, & G, and associated facilities are not located or occurring within 100 feet of any Class I or II watercourse or within 50 feet of any Class III watercourse or wetland, buffers maintain natural slopes with native vegetation, and buffers are of sufficient width to filter wastes from runoff discharging from production lands and associated facilities to all wetlands, streams, drainage ditches, or other conveyances.

Cultivation Areas E, F and, G are located within the riparian buffer areas of multiple Class III watercourses. These cultivation areas have been abandoned and relocated to active cultivation areas. However, remaining cultivation-related materials still remain at these cultivation areas (CA E, F, & G) and shall be removed, as feasible. Materials to be removed include but are not limited to pots, fencing, and water piping. It is not feasible to remove the cultivation soils from the cultivation areas due to location and access difficulties. Remnant cultivation soils shall be removed from their pots and contoured in the native soil within the immediate vicinity of the pot. These soils shall then be seeded with native grass seed and mulched with any nearby native leaf litter and duff, twigs, and branches. Some pots at Cultivation Area F are located within the Class III watercourse running through the cultivation area. These pots and soil, and any other pots located within 20 feet of the watercourse, shall be removed a minimum of 20 feet from the watercourse where the soils will then be treated as described above. No soil and slope stabilizing and/or vegetation planting will be required for the decommissioning of these cultivation areas (CA E, F, G). The cultivation areas are heavily vegetated with native woody and grass species. Further details can be found in the Mitigation Report to follow.

4. Spoils Management

Currently, no spoils are stored or placed in or where they can enter any surface water. Any/all spoils generated through development or maintenance of roads, driveways, have not been sidecast in any location where they can enter or be transported to surface waters. Any/all spoils shall be adequately contained or stabilized to prevent sediment delivery to surface waters earthen fill pads, or other cleared or filled areas.

If any further spoiling material is required, such as from stream crossing installation or other grading, the discharger shall follow the BMPs in Appendix B of the Order, under Spoil Management. Spoil sites shall be located outside any riparian area (50 feet for Class III and 100 feet for Class III) and shall be stabilized and contained as per the BMPs.

Summary of Standard Conditions Compliance (Cont.)

5. Water Storage and Use

All water used for irrigation and domestic uses is derived from three surface water diversions located on the property. A Lake and Streambed Alteration Agreement (LSAA/1600) agreement with California Department of Fish & Wildlife (CDFW) has been filed as of the writing of this assessment.

Diversion intake infrastructure at Point of Diversion 1 consists of a 1-inch poly-pipe buried in at the head of a Class II watercourse. It was not apparent that the poly-pipe was attached to a diversion structure. Water from this diversion is gravity fed to storage tanks nearby the residence and is then pumped up to other storage tanks located on the property.

Diversion intake infrastructure at Point of Diversion 2 consists of a bucket placed at the outlet of a watercourse crossing culvert. Water from the bucket is conveyed to a pickle barrel located downstream 20 feet. Water from the pickle barrel is then gravity fed to storage tanks nearby the residence and is then pumped up to other storage tanks located on the property.

Diversion intake infrastructure at Point of Diversion 3 consists of a bucket placed at the outlet of a watercourse crossing culvert. Water from the bucket is conveyed to a pickle barrel located downstream 20 feet. Water from the pickle barrel is then gravity fed to storage tanks located up slope, to the north, of Cultivation Area D.

At this time, the discharger has approximately 45,800 gallons of hard tank storage. This volume of storage is insufficient to allow for full forbearance during the Forbearance Period. It is estimated that the discharger uses 244,500 gallons of water during the cultivation season (April to October) for agricultural use. The discharger shall obtain a well, more water storage, approximately 200,000 gallons, or a combination of both to meet forbearance requirements.

Water metering device(s) shall be installed immediately to meter water used for the irrigation of cannabis. Recorded water use data shall be used to determine remaining storage needs to meet full forbearance. Any additional storage needed to meet water needs during the Forbearance Period shall be installed and filled prior to the next Forbearance Periods. Separate water meter(s) shall be installed to record domestic water use from the diversions. A float valve shall be installed on diversion infrastructure or water storage tanks to prevent the overflowing of tanks and unnecessary diversion of water resources when water storage infrastructure has filled. The discharger shall also implement water conservation measures such as drip line irrigation, morning or evening watering, and mulch or cover cropping of cultivated top soils. Monthly water usage estimates and the season total are as follows below.

	Jan	Feb	March	April (25%)	May (60%)	Jun (80%)	Jul (100%)	Aug (100%)	Sep (70%	Oct (20%)	Nov	Dec
Agriculture				13,863	32,198	42,930	53,663	53,663	37,564	10,733		
Sq. ft. = 23,850								% = percent of peak usage				

Total AG Water Use =	244,612

A Lake and Streambed Alteration Agreement (LSAA/1600) with the California Department of Fish and Wildlife (CDFW), as well as an Initial Statement of Water Diversion and Use and a Small Irrigation and Use

Summary of Standard Conditions Compliance (Cont.)

Registration (SIUR) with the California State Water Resource Control Board Division of Water Rights, will need to be obtained for the use of the surface water diversions. Any additional guidelines, treatments, or restrictions set forth under the finalized Lake and Stream Alteration Agreement or the Small Irrigation and Use Requisition shall be followed.

6. Irrigation Runoff

During multiple visits to the property, no irrigation runoff, or evidence of such runoff, was observed at any of the cultivation sites.

7. Fertilizers and Soil Amendments

Fertilizers and soil amendments were being stored on the property at the time of the assessment. In-use fertilizers are stored within the residences and sheds adjacent to the residences. If fertilizers are stored adjacent to mixing tanks, it is recommended that the discharger stores in-use fertilizers in a small storage container, such as a tote or deck box, adjacent to the mixing tanks.

The discharger shall ensure that all fertilizers and soil amendments are stored in structures on the property in a manner in which they cannot enter or be transported into surface waters and so that nutrients or other pollutants cannot be leached into groundwater. Prior to the wet season, any and all remaining stored soil and soil amendment piles shall be either used or contained with staked wattles and/or earthen berms. Fertilizers and soil amendments shall be applied and used per the manufacturers guidelines.

8. Pesticides and Herbicides

No pesticides and fungicides were found stored on the property at the time of the assessment. The discharger shall ensure that all pesticide and herbicide products on the property are currently used, and stored in closed structures, to ensure that they do not enter or are released into surface or ground waters and that the use of pesticide products is consistent with product labeling.

9. Petroleum Products and Other Chemicals

Currently, there is no bulk fuel storage present on the property. Small quantities of fuel in canisters are stored in the shed next to Cultivation Area A, the barn, and nearby the residences.

All bulk fuel storage or petroleum products, any/all future petroleum products and other liquid chemicals, including but not limited to diesel, biodiesel, gasoline, and oils shall be stored so as to prevent their spillage, discharge, or seepage into receiving waters. Storage tanks and containers shall be of suitable material and construction to be compatible with the substance(s) stored and conditions of storage such as pressure and temperature. Above ground storage tanks and containers shall be provided with a secondary means of containment for the entire capacity of the largest single container and sufficient cover shall be provided to prevent any/all precipitation from entering said secondary containment vessel. Dischargers shall ensure that diked areas are sufficiently impervious to contain discharged chemicals. Discharger(s) shall implement spill prevention, control, and countermeasures (SPCC) and have appropriate cleanup materials available onsite if the volume of a fuel container is greater than 1,320 gallons. Underground storage tanks 110 gallons and larger shall be registered with the appropriate County Health Department and comply with State and local requirements for leak detection, spill overflow, corrosion protection, and insurance coverage.

Summary of Standard Conditions Compliance (Cont.)

On-site storage of petroleum products, or other fuels used for commercial activities may require registration as hazardous materials through the California Environmental Reporting System (CERS). Additionally, the waste oil generated from commercial activities (generators) is considered hazardous waste and requires addition reporting. This discharger is advised to contact local agencies to find out if such reporting is applicable to currently operations.

10. Cultivation-Related Wastes

Organic cultivation-related wastes are collected from the cultivation areas and composted or burned. The discharger shall ensure that the locations where organic wastes are composted or burned are minimized in number and are sited outside of watercourse riparian areas and away from any form of surface runoff. Two cultivation-related soil piles were found on the property at the time of the assessment. A soil pile located at Site 06 only requires containment while a soil pile located at Site 09 requires removal from its current location. Further details can be found in the Mitigation Report to follow.

Non-organic cultivation-related wastes are stored in lidded trashcans and garbage bags adjacent to or in the residence, sheds, and cultivation areas and are disposed of regularly at the nearest solid waste transfer station. The discharger shall continue to gather and properly dispose of cultivation-related wastes and ensure that wastes are adequately contained from scavenging wildlife, and cannot be transported away from storage areas by wind or surface runoff.

11. Refuse and Human Waste

Garbage and refuse is stored on the property within lidded trash cans and garbage bags and hauled away to a landfill transfer station periodically. The discharger shall continue to gather and properly dispose of refuse and ensure that refuse is adequately contained from scavenging wildlife, and cannot be transported away from storage areas by wind or surface runoff.

Human waste is managed by a septic system attached to the residences and a composting toilet located in a structure to the approximately 50 feet northeast of Site 07. The composting toilet is located outside of the Class III watercourse riparian buffer to the southwest and does not appear to be a threat to water quality. It is the discharger's responsibility to ensure compliance with the Humboldt County Department of Environmental Health and Human Services.

12. Remediation/Clean-up/Restoration

Currently, five of the Standard Conditions are not being met; Site Maintenance, Erosion Control, and Drainage Features, Stream Crossing Maintenance, Riparian and Wetland Protection and Management, Water Storage and Use, and Cultivation-Related Wastes. Sites will be treated in accordance with regulations, following approval of any and/or all necessary permits, and done in accordance with the BMP's listed in Appendix B of the Order and those included in this WRPP. Additionally, several other general recommendations have been made as follows:

General Recommendations

- ☐ Fertilizer, soil amendments, and pesticide use it to be recorded in such a manner that cumulative annual totals are recorded for annual reporting.
- ☐ Store in-use fertilizers in a small storage container, such as a tote or deck box, adjacent to the mixing tanks.
- ☐ All generators and petroleum powered pumps are required to have spill trays or secondary containment placed underneath them when using, fueling, or changing oil on them to prevent the potential for leeching, seepage or spillage of petroleum products. All spill trays and containment structures require cover from precipitation. See BMPs: See BMPs: Generator, Fuel, Oil Management and General Recommendations - Petroleum products and hazardous materials specifications.
- ☐ It is recommended that all petroleum products and other chemicals are registered with the California Environmental Reporting System (CERS) to satisfy future licensing requirements.
- ☐ Install staked wattles or an earthen berm around cultivation soils piles prior to the winter period, annually.
- ☐ Water use shall be designed and metered such that water used for the irrigation of cannabis will be recorded separately from domestic use. Water use for the irrigation of cannabis is to be recorded monthly for annual reporting.
- ☐ Ensure lids are secured on all water storage tanks to prevent wildlife from becoming entrapped within the tank.
- ☐ Install float valves, or implement another equivalent system, on all applicable water storage and transfer tanks to prevent unnecessary water diversion and the overflowing of water tanks.
- ☐ Frequent use of un-surfaced roads should be avoided, particularly when road surfaces are soft/saturated.
- ☐ All culverts should be inspected regularly during the winter months to check for plugging, blockage, or other issues.
- ☐ Existing or newly installed road surface drainage structures such as water bars, rolling dips, ditch relief culverts, and intentionally in/out-sloped segments of road shall be maintained to ensure continued function of capturing and draining surface runoff.

Interim Measures

- ☐ Site 05: Install a series of three to five staked wattles across the head of the Class III watercourse at this site. Spread a minimum of 4 inches of straw or wood chips behind the wattles. See Site 04 for rock surfacing treatment prescriptions.
- ☐ Site 09: Remove this pile of cultivation-related soil spoils from this area. Use the soil or move it to the cultivation-related soil spoils pile at Site 06. Seed any remnant soils with grasses and mulch with straw or woodchips.

STATEMENT OF CONTINGENT AND LIMITING CONDITIONS CONCERNING THE PREPARATION AND USE OF WATER RESOURCE PROTECTION PLAN

Prepared by Timberland Resource Consultants

1. This Water Resource Protection Plan has been prepared for the property within APN 216-013-011; 216-012-007 in Humboldt County, at the request of the Client.

2. Timberland Resource Consultants does not assume any liability for the use or misuse of the information in this Water Resource Protection Plan.

3. The information is based upon conditions apparent to Timberland Resource Consultants at the time the inspection was conducted. Changes due to land use activities or environmental factors occurring after this inspection have not been considered in this Water Resource Protection Plan.

4. Maps, photos, and any other graphical information presented in this report are for illustrative purposes. Their scales are approximate, and they are not to be used for locating and establishing boundary lines.

5. The conditions presented in this Water Resource Protection Plan may differ from those made by others or from changes on the property occurring after the inspection was conducted. Timberland Resource Consultants does not guarantee this work against such differences.

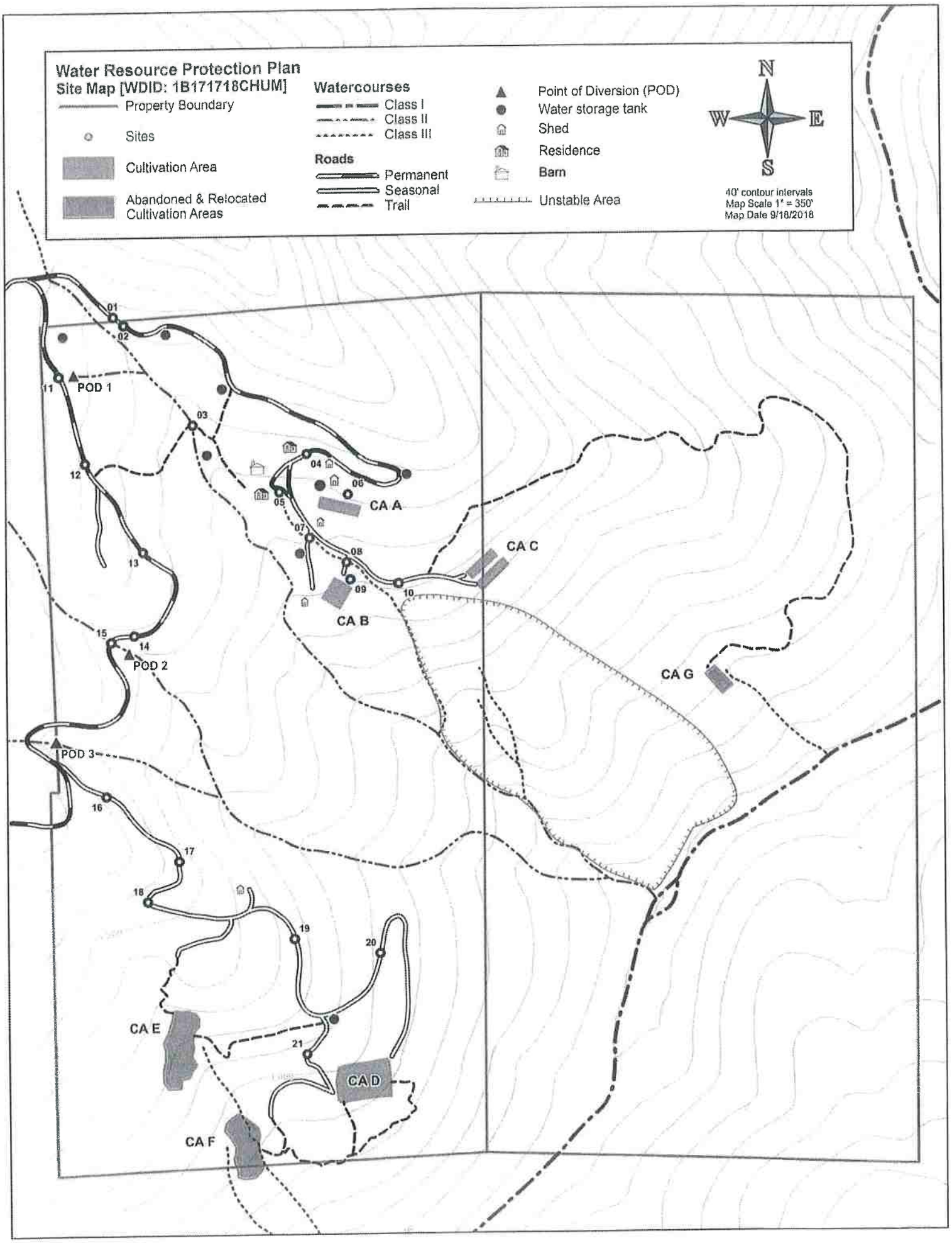
6. Timberland Resource Consultants did not conduct an investigation on a legal survey of the property.

7. Persons using this Water Resource Protection Plan are advised to contact Timberland Resource Consultants prior to such use.

8. Timberland Resource Consultants will not discuss this report or reproduce it for anyone other than the Client named in this report without authorization from the Client.

Forrest Hansen

Timberland Resource Consultants


Water Resource Protection Plan
Site Map [WDID: 1B171718CHUM]
Property Boundary
Sites
Cultivation Area
Abandoned & Relocated Cultivation Areas
Watercourses
Class I
Class II
Class III
Roads
Permanent
Seasonal
Trail
Point of Diversion (POD)
Water storage tank
Shed
Residence
Barn
Unstable Area
N
W
E
S
40' contour intervals
Map Scale 1" = 350'
Map Date 9/18/2018
01
02
11
POD 1
03
12
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CA A
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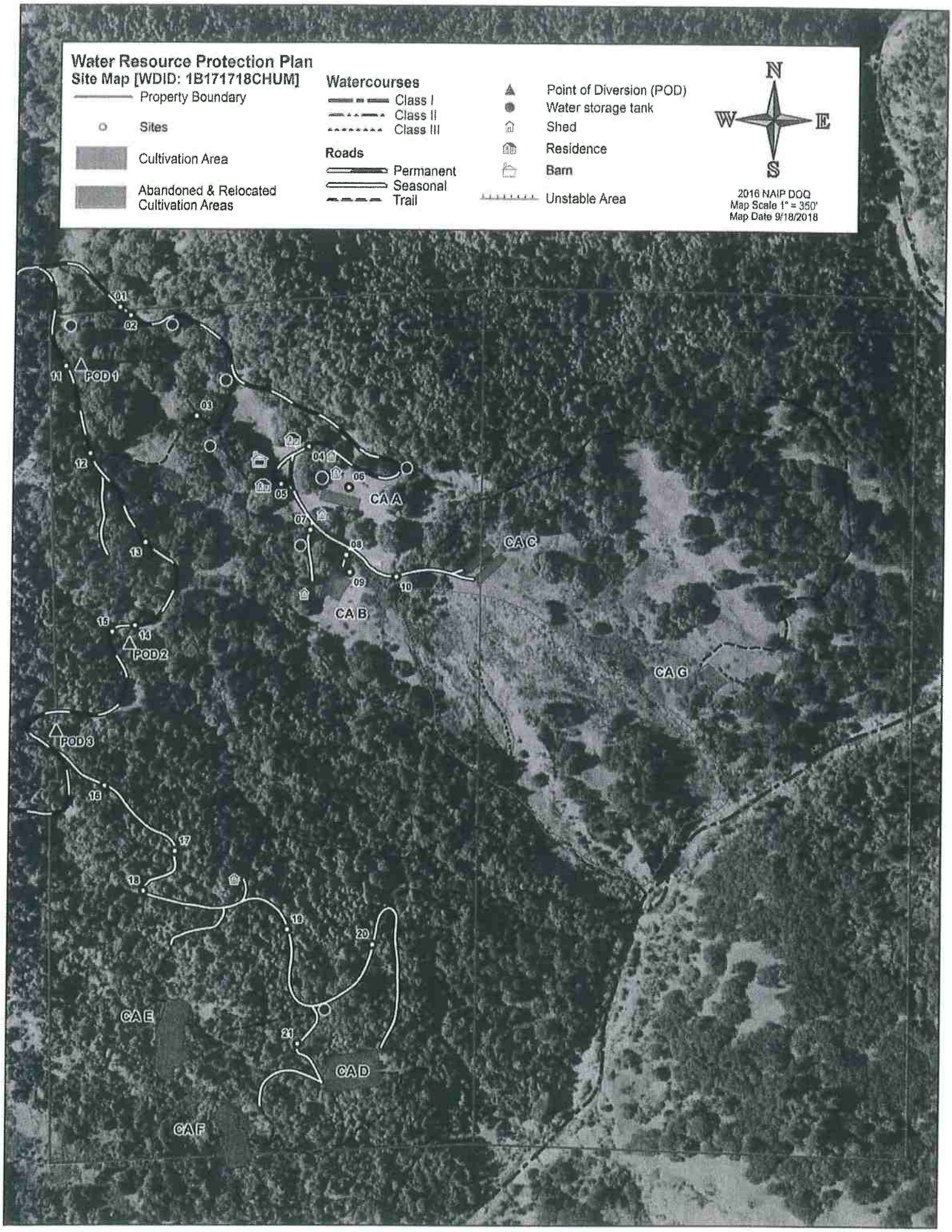
08
09
CA B
10
CA C
13
15
14
POD 2
CA G
POD 3
16
17
18
19
20
CA E
21
CA D
CA F


Water Resource Protection Plan
Site Map [WDID: 1B171718CHUM]
Property Boundary
Sites
Cultivation Area
Abandoned & Relocated Cultivation Areas
Watercourses
Class I
Class II
Class III
Roads
Permanent
Seasonal
Trail
Point of Diversion (POD)
Water storage tank
Shed
Residence
Barn
Unstable Area
N
W
E
S
2016 NAIP DOQ
Map Scale 1" = 350'
Map Date 9/18/2018
01
02
11
POD 1
03
12
04
05
06
CA A
07
08
CA C
13
09
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CA B
15
14
POD 2
CA G
POD 3
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CA E
21
CA D
CA F

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WRPP - Mitigation Report

WDID# - 1B171718CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
1	-123.709425 40.028202	Permanent	X	X	-	A.1.	Prior to 10/15/20	

Current Condition: Ditch relief culvert consisting of a 24-inch diameter plastic double-walled pipe. The culvert is functioning properly but lacks adequate rock armoring of the outlet.

Prescribed Action: Rock armor the outlet per attached BMPs: See Inlet and Outlet Armoring specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
2	-123.709354 40.02816	Permanent	X	X	-	A.1.	Prior to 10/15/20	

Current Condition: Road surface runoff is beginning to concentrate on the road surface further down grade to the southeast.

Prescribed Action: Install a Type 1 rocked rolling dip per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
3	-123.708562 40.027308	Trail	-	X	-	A.2.	As required	

Current Condition: Class II watercourse crossing consisting of a small wooden footbridge. There we no obvious issues with the footbridge affecting the watercourse. The only potential issue was two post and pier foundations placed into the watercourse to support the bridge from the center.

Prescribed Action: None. Any treatments or recommendations in the Lake and Stream Alteration Agreement (LSAA/1600) with the California Department of Fish & Wildlife shall be followed.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
4	-123.707408 40.027037	Permanent	X	X	-	A.1.	Prior to 10/15/19	

Current Condition: An unsurfaced road is located above and along a Class III watercourse from this site (Site 04) to Site 05 and down to Site 10. Road surface runoff is discharging into the head of a Class III watercourse at Site 05, and into the same watercourse at Site 07 and Site 08. The road surface runoff then drains into a swale feature at Site 10.

Prescribed Action: Apply rock surfacing to all road surfaces around both residences and the barn, from Site 04 to Site 05. Apply rock surfacing to all road surfaces from Sites 04 and 05 to Site 10. Apply rock surfacing across the watercourse crossings at Sites 07 and 08.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
5	-123.707629 40.026753	-	X	X	-	A.1.	Immediately	

Current Condition: Road surface runoff is discharging into the head of a Class III watercourse from an unsurfaced parking and turn around area located directly upslope of the head of the watercourse.

Prescribed Action: Install a series of three to five staked wattles across the head of the Class III watercourse. Spread a minimum of 4 inches of straw or wood chips behind the wattles. See Site 04 for rock surfacing treatment prescriptions.

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WDID# - 1B171718CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
6	-123.706884 40.026733	-	X	X	-	A.10.	Annually prior to 10/15	

Current Condition: Cultivation-related soil pile without any containment.

Prescribed Action: Install staked wattles around the downslope side of the pile of cultivation soils prior to the winter period, annually.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
7	-123.707318 40.026375	Seasonal	X	X	X	A.1.	Prior to 10/15/20	

Current Condition: Class III watercourse crossing consisting of a dirt ford crossing. The crossing, and approaches, to the crossing are not surfaced adequately with rock armoring and surfacing.

Prescribed Action: Install a rocked ford per attached BMPs: See Rocked Ford specifications. Rock the approaches 20 feet in either direction from the crossing point.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
8	-123.706907 40.02619	Seasonal	X	X	X	A.2.	Prior to 10/15/19	

Current Condition: Class III watercourse crossing consisting of an 18-inch diameter plastic double-walled culvert. The culvert is adequately sized for the watercourse's 100-year storm event's predicted cfs (cubic feet second) but undersized for the associated debris load. The culvert was installed correctly, recently (estimated within the past 5 to 10 years), and is functioning adequately.

Prescribed Action: Apply rock surfacing from the crossing point to Cultivation Area B. Monitor and maintain per attached BMPs: See Winterization - Crossings specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
9	-123.706856 40.026029	Seasonal	X	X	-	A.10.	Immediately	

Current Condition: Cultivation-related soil pile without any containment is located directly above a Class III watercourse.

Prescribed Action: Interim measures: Remove this pile of cultivation-related soil spoils from this area. Use the soil or move it to the cultivation-related soil spoils pile at Site 06. Seed any remnant soils with grasses and mulch with straw or woodchips.
Permanent measures: Extend the existing wildlife fence around the soil pile and to the outlet of the watercourse crossing at Site 08 to prevent any use of the area where the soil pile is currently located.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
10	-123.706345 40.025997	Seasonal	-	X	-	A.1.	As required	

Current Condition: Rolling dip with a rock armored outlet rock.

Prescribed Action: None. Monitor and maintain per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

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WRPP - Mitigation Report

WDID# - 1B171718CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
11	-123.710012 40.027708	Permanent	X	X	-	A.1.	Prior to 10/15/19	

Current Condition: A long undrained inside ditch is draining too much road surface runoff to the ditch relief culvert at Site 12.

Prescribed Action: Install a rocked rolling dip in conjunction with an 18-inch diameter ditch relief culvert per attached BMP's: See Waterbar/Rolling Dip Combined with DRC, Rolling Dip Design and Placement, and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
12	-123.70972 40.026989	Permanent	X	X	-	A.1.	Prior to 10/15/19	

Current Condition: Ditch relief culvert consisting of a 15-inch diameter corrugated metal pipe. The ditch relief culvert has an accumulation of debris at the inlet, is installed at a poor angle, eroding at the outlet, and is receiving too much concentrated road surface runoff. Concentration road surface runoff also being constrained to the road surface and bypassing this drainage feature.

Prescribed Action: Install a rocked rolling dip in conjunction with the ditch relief culvert (DRC) per BMPs: See Waterbar/Rolling Dip Combined with DRC, Rolling Dip Design and Placement, and Rocked Rolling Dip Design and Placement specifications. Clear the inlet of the ditch relief culvert of debris and sediment. Rock armor the outlet per attached BMPs: See Inlet and Outlet Rock Armoring specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
13	-123.709094 40.026258	Permanent	X	X	-	A.1.	Prior to 10/15/19	

Current Condition: Concentrated road surface runoff is eroding the road surface before draining over the outboard edge of the road. The concentrated road surface runoff has the potential to continue down the road surface to Site 14 and Site 15, and discharge into a watercourse, if an adequate drainage feature is installed.

Prescribed Action: Install a Type 1 rolling dip per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
14	-123.709187 40.025567	Permanent	X	X	-	A.1.	Prior to 10/15/19	

Current Condition: An inside ditch has filled with debris and is diverting onto the road surface. The road surface runoff drains into watercourse south of the watercourse crossing at Site 15.

Prescribed Action: Clear the inside ditch up grade to the east approximately 60 feet. Install a hydrologic disconnect Type 1 rocked rolling dip per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement.

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WRPP - Mitigation Report

WDID# - 1B171718CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
15	-123.709434 40.025511	Permanent	X	X	X	A.2.	Prior to 10/15/20	

Current Condition: Class II watercourse crossing consisting of a 36-inch diameter corrugated metal pipe. The culvert is adequately sized for the watercourse's 100-year storm event's predicted cfs but undersized for the associated debris load. The culvert was installed correctly, recently (estimated past 5 to 10 years), and is functioning adequately. However, the inlet lacks rock armoring.

Prescribed Action: Rock armor the inlet per attached BMPs: See Permanent Culvert Crossing Design (Inlet and Outlet Armoring) specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
16	-123.709481 40.024239	Seasonal	-	X	-	A.1.	As required	

Current Condition: Existing functional rolling dip.

Prescribed Action: None. Monitor and maintain per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
17	-123.708713 40.023717	Seasonal	-	X	-	A.1.	As required	

Current Condition: Existing functional rolling dip.

Prescribed Action: None. Monitor and maintain per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
18	-123.708962 40.02344	Seasonal	X	X	-	A.1.	Prior to 10/15/20	

Current Condition: Steep segment of road without adequate rock surfacing.

Prescribed Action: Apply rock surfacing to the road surface for approximately 100 feet with the Site 18 point, the hairpin turn, as the center point.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
19	-123.707453 40.023062	Seasonal	-	X	-	A.1.	As required	

Current Condition: Existing functional rolling dip.

Prescribed Action: None. Monitor and maintain per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

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WRPP - Mitigation Report

WDID# - 1B171718CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
20	-123.706525 40.022945	Seasonal	-	X	-	A.1.	As required	

Current Condition: Existing functional rolling dip.

Prescribed Action: None. Monitor and maintain per attached BMPs: See Rolling Dip Design and Placement and Rocked Rolling Dip Design and Placement specifications.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
21	-123.707315 40.022115	Seasonal	X	X	-	A.1.	Prior to 10/15/20	

Current Condition: Steep segment of road without adequate rock surfacing.

Prescribed Action: Apply rock surfacing to the road surface for approximately 125 feet down grade, to the south, and for approximately 140 feet up grade, to the north.

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
CA E, F, & G	N/A	-	X	X	-	A.3., A.10.	Prior to 10/15/20	

Current Condition: Abandoned cultivation areas are located on watercourses or within the watercourse riparian buffer area where runoff and cultivation-related wastes can enter surface waters.

Prescribed Action: Remaining cultivation-related materials still remain at these cultivation areas (CA E, F, & G) and shall be removed, as feasible. Materials to be removed include but are not limited to pots, fencing, and water piping. It is not feasible to remove the cultivation soils from the cultivation areas due to location and access difficulties. Remnant cultivation soils shall be removed from their pots and contoured in the native soil within the immediate vicinity of the pot. These soils shall then be seeded with native grass seed and mulched with any nearby native leaf litter and duff, twigs, and branches. Some pots at Cultivation Area F are located within the Class III watercourse running through the cultivation area. These pots and soil, and any other pots located within 20 feet of the watercourse, shall be removed a minimum of 20 feet from the watercourse where the soils will then be treated as described above.

BMP: Winterization and Interim Treatments for Erosion Control

- **Roads**
  - Existing or newly installed road surface drainage structures such as water bars, rolling dips, ditch relief culverts, and intentionally in/out-sloped segments of road shall be maintained to ensure continued function of capturing and draining surface runoff.
  - Hand tool kick-outs (lead out ditch) for existing wheel rut, surface run-off confinement.
  - Temporary waterbar/cross-wattles installed on road/trail sections of concentrating surface runoff.
  - Clean existing DRC inlets, outlets, and contributing ditch lines of current and potential blockage debris by hand.
  - Hand place energy dissipating rock/small woody debris at DRC outlets where erosion is occurring.
  - Wattles/straw bales placed at road runoff delivery sites.
  - Touch-up with hand tools of existing surface drainage structures (kick-outs, rolling dips, and waterbars).
  - Seed and straw un-used, or to be abandoned, road surfaces where erosion is occurring.
  - Frequent use of un-surfaced roads should be avoided, particularly when road surfaces are soft/saturated.

- **Crossings**
  - Clean inlets, outlets, and channels above of current and potential blockage debris by hand.
  - Hand place energy dissipating rock/SWD at DRC outlets.
  - Hand placement of rock armor around culvert inlets.
  - Installation of wattles along the outboard road edge of out-sloped crossing with direct delivery of road surface runoff is occurring.
  - Hand placement of rock on crossing fill faces where erosion is/may occur as a result of poor crossing construction.

- **Cultivation Areas**
  - Use hand tools to capture cultivation related soils that are not contained (soil from post-harvest plant removal, soil/planter removal, general spillage).
  - Treat beds, pots, new soil storage piles, spent soil piles, and soil disposal piles with cover crops for soil stability and potentially nitrogen fixing/soil amendment.
  - Bagged potting soil should be covered.
  - Install staked wattles or an earthen berm around cultivation soils piles prior to the winter period, annually.
  - Any soil amendment, fertilizer, herbicide, or pesticide that is not 100% sealed should be stored under cover.
  - Cultivation sites with poor or concentrating drainage can have wattles or bales installed prior to winter to help prevent sediment and nutrients from leaving the site.
  - Plastic netting shall be disposed of or stored where it is inaccessible to wildlife.
  - Tarps/dep covers shall be stored so they cannot be blown away.
  - General waste from growing season gathered up and disposed of.
  - Exposed soil surfaces in the cultivation area, as well as graded fill slopes should be seeded, strawed, mulched, jute netted as needed.

- **General Areas**
  - Remove all refuse prior to leaving property for the season.
  - Back fill pit toilets to be abandoned.

BMP: General Recommendations

- **Fertilizers, soil amendments, and pesticides**
  - Fertilizer, soil amendments, and pesticide use it to be recorded in such a manner that cumulative annual totals are recorded for annual reporting.
  - Store in-use fertilizers in a securable storage container, such as a tote or deck box, adjacent to the mixing tanks.

- **Petroleum products and hazardous materials**
  - Utilize spill trays/containment structures and cover over the containment when using, fueling, changing oil on portable generators or petroleum powered water pumps to prevent the potential for leeching, seepage or spillage of petroleum products.
  - It is recommended that all petroleum products and other chemicals are registered with the California Environmental Reporting System (CERS) to satisfy future licensing requirements.

- **Water storage and Use**
  - Water use shall be designed and metered such that water used for the irrigation of cannabis will be recorded separately from domestic use. Water use for the irrigation of cannabis is to be recorded monthly for annual reporting.
  - Ensure lids are secured on all water storage tanks to prevent wildlife from becoming entrapped within the tank.
  - Install float valves, or implement another equivalent system, on all applicable water storage and transfer tanks to prevent unnecessary water diversion and the overflowing of water tanks.

BMP: General Operations BMPs

- If operations require moving of equipment across a flowing stream, such operations shall be conducted without causing a prolonged visible increase in stream turbidity. For repeated crossings, the operator shall install a bridge, culvert, or rock-lined crossing.

- During construction in flowing water, which can transport sediment downstream, the flow shall be diverted around the work area by pipe, pumping, temporary diversion channel or other suitable means. When any dam or artificial obstruction is being constructed, maintained, or placed in operation, sufficient water shall at all times be allowed to pass downstream to maintain fish life below the dam. Equipment may be operated in the channel of flowing live streams only as necessary to construct the described construction.

- Disturbance or removal of vegetation shall not exceed the minimum necessary to complete operations. The disturbed portion of any stream channel shall be restored to as near their original condition as possible. Restoration shall include the mulching of stripped or exposed dirt areas at crossing sites prior to the end of the work period.

- Structures and associated materials not designed to withstand high seasonal flow shall be removed to areas above the high-water mark before such flows occur.

- No debris, soil, silt, sand, bark, slash, sawdust, rubbish, cement or concrete washing, oil or petroleum products, or other organic or earthen material from any logging, construction, or associated activity of whatever nature shall be allowed to enter into or be placed where it may be washed by rainfall or runoff into waters of the State. When operations are completed, any excess materials or debris shall be removed from the work area. No rubbish shall be deposited within 150 feet of the high-water mark of any stream.

BMP: General Erosion Control

- Timing for soil stabilization measures within the 100 feet of a watercourse or lake: For areas disturbed from May 1 through October 15, treatment shall be completed prior to the start of any rain that causes overland flow across or along the disturbed surface. For areas disturbed from October 16 through April 30, treatment shall be completed prior to any day for which a chance of rain of 30 percent or greater is forecast by the National Weather Service or within 10 days, whichever is earlier.

- Within 100 feet of a watercourse or lake, the traveled surface of logging roads shall be treated to prevent waterborne transport of sediment and concentration of runoff that results from operations. Treatment may consist of, but not limited to, rocking, out sloping, rolling dips, cross drains, water bars, slope stabilization measures, or other practices appropriate to site-specific conditions.

- The treatment for other disturbed areas within 100 feet of a watercourse or lake, including: (A) areas exceeding 100 contiguous square feet where operations have exposed bare soil, (B) approaches to road watercourse crossings out to 100 feet or the nearest drainage facility, whichever is farthest, (C) road cut banks and fills, and (D) any other area of disturbed soil that threatens to discharge sediment into waters in amounts deleterious to the quality and beneficial uses of water, shall be grass seeded and mulched with straw or fine slash. Grass seed shall be applied at a rate exceeding 100 pounds per acre. Straw mulch shall be applied in amounts sufficient to provide at least 2- 4-inch depth of straw with minimum 90% coverage. Slash may be substituted for straw mulch provided the depth, texture, and ground contact are equivalent to at least 2 – 4 inches of straw mulch. Any treated area that has been subject to reuse or has less than 90% surface cover shall be treated again prior to the end of operations.

- Within 100 feet of a watercourse or lake, where the undisturbed natural ground cover cannot effectively protect beneficial uses of water from operations, the ground shall be treated with slope stabilization measures described in #3 above per timing described in #1 above.

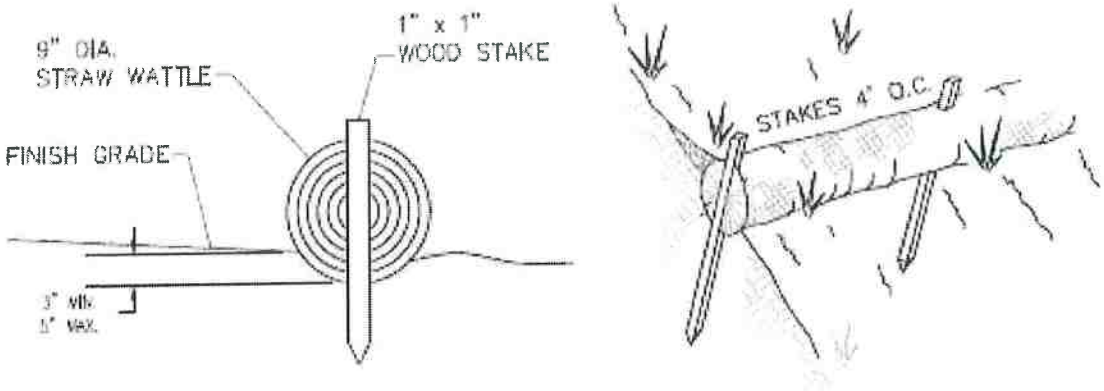
- Side cast or fill material extending more than 20 feet in slope distance from the outside edge of a landing which has access to a watercourse or lake shall be treated with slope stabilization measures described in #3 above. Timing shall occur per #1 above unless outside 100 feet of a watercourse or lake, in which completion date is October 15.

- All roads shall have drainage and/or drainage collection and storage facilities installed as soon as practical following operations and prior to either (1) the start of any rain which causes overland flow across or along the disturbed surface within 100 feet of a watercourse or lake protection, or (2) any day with a National Weather Service forecast of a chance of rain of 30 percent or more, a flash flood warning, or a flash flood watch.

BMP: General Erosion Control (Cont.)

- Erosion control and sediment detention devices and materials shall be incorporated into the cleanup/restoration work design and installed prior to the end of project work and before the beginning of the rainy season. Any continuing, approved project work conducted after October 15 shall have erosion control works completed up-to-date and daily.
- Erosion control materials shall be, at minimum, stored on-site at all times during approved project work between May 1 and October 15.
- Approved project work within the 5-year flood plain shall not begin until all temporary erosion controls (straw bales or silt fences that are effectively keyed-in) are installed downslope of cleanup/restoration activities.
- Non-invasive, non-persistent grass species (e.g., barley grass) may be used for their temporary erosion control benefits to stabilize disturbed slopes and prevent exposure of disturbed soils to rainfall.
- Upon work completion, all exposed soil present in and around the cleanup/restoration sites shall be stabilized within 7 days.
- Soils exposed by cleanup/restoration operations shall be seeded and mulched to prevent sediment runoff and transport.
- Straw Wattles (if used) shall be installed with 18 or 24-inch wood stakes at four feet on center. The ends of adjacent straw wattles shall be abutted to each other snugly or overlapped by six inches. Wattles shall be installed so that the wattle is in firm contact with the ground surface.

BMP: General Erosion Control (Cont.)

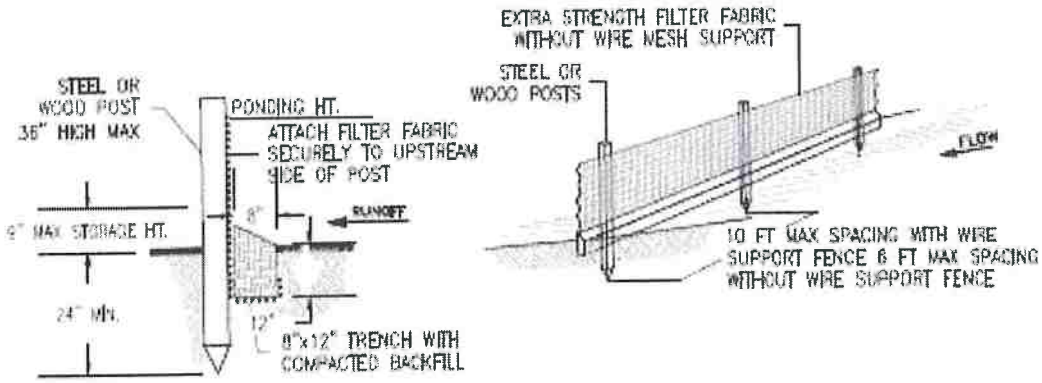


STRAW WATTLE NOTES:

1. STRAW WATTLES SHALL BE INSTALLED WITH 18 OR 24 INCH WOOD STAKES AT FOUR FEET ON CENTER. THE ENDS OF ADJACENT STRAW WATTLES SHALL BE ABUTTED TO EACH OTHER SNUGLY OR OVERLAPPED BY SIX INCHES.
2. STRAW ROLL INSTALLATION REQUIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3"–5" DEEP. RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND THE ROLL.

STRAW WATTLE INSTALLATION DETAIL

NTS



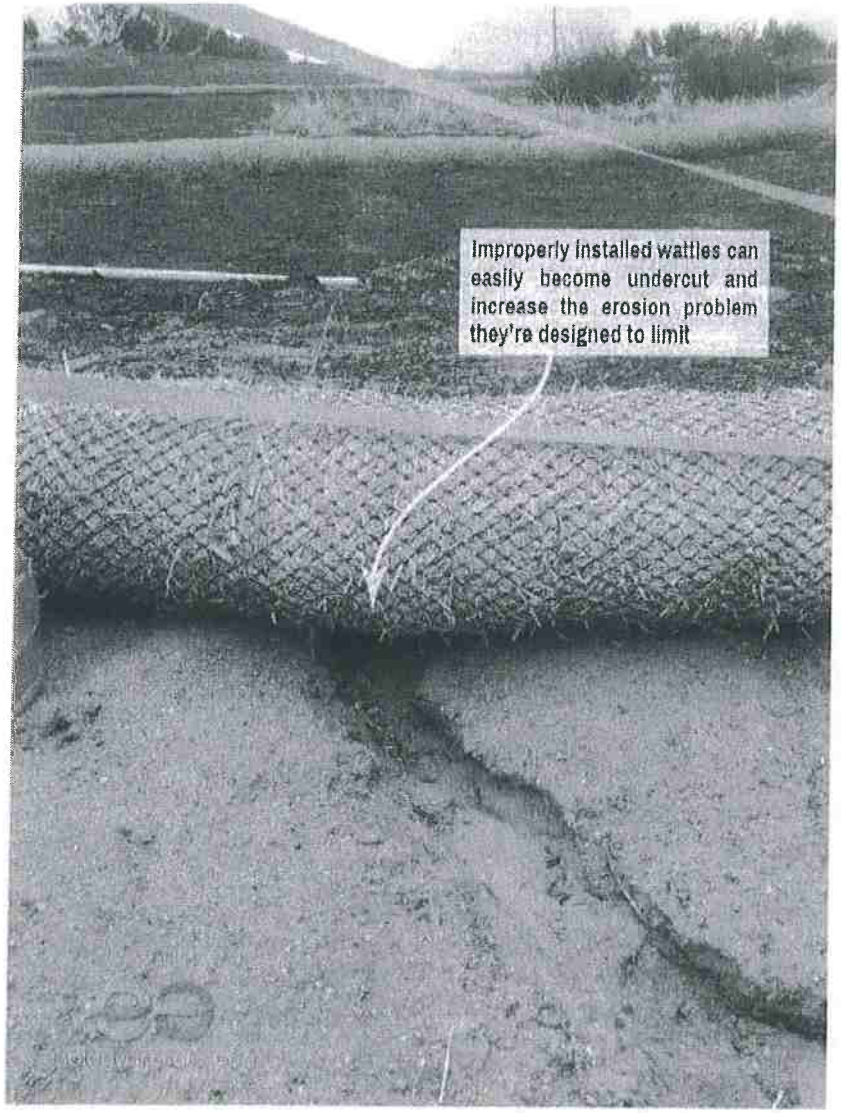
SILT FENCE NOTES:

1. THE CONTRACTOR SHALL INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT.
2. CONTRACTOR SHALL REMOVE SEDIMENT AS NECESSARY. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND IN AN AREA THAT CAN BE PERMANENTLY STABILIZED.
3. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.

SILT FENCE DETAILS

NTS

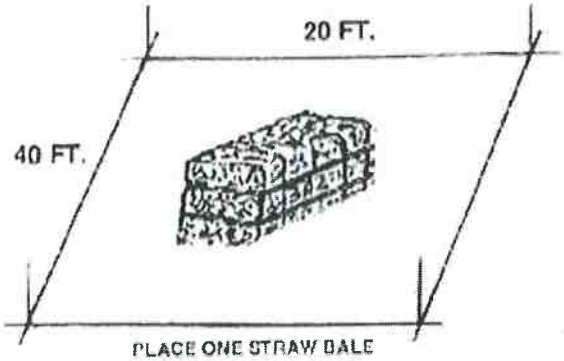
BMP: General Erosion Control (Cont.)



BMP: General Erosion Control (Cont.)

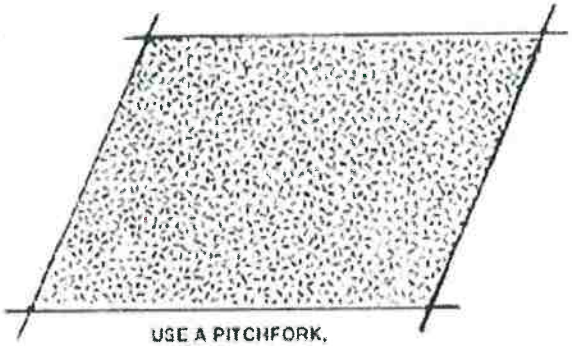
SPREAD THE STRAW

MARK OFF 800 SQ FT. PLOTS



PLACE ONE STRAW BALE PER PLOT (~74 POUNDS). THIS IS EQUIVALENT TO 2 TONS PER ACRE.

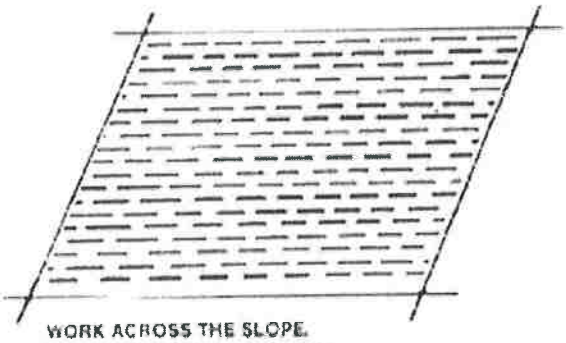
SPREAD EVENLY



USE A PITCHFORK, SPADING FORK, OR BY HAND

ANCHOR THE STRAW

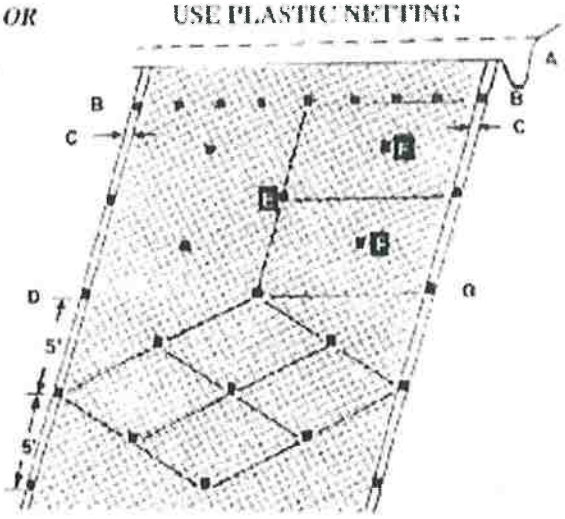
CRIMP BY HAND



WORK ACROSS THE SLOPE.
PUNCH STRAW 4 INCHES DEEP.
A SQUARE END SPADE WORKS WELL.
MAKE PUNCH EVERY 12 INCHES.

OR

USE PLASTIC NETTING



A. LAY BIRD CONTROL NETTING OR SIMILAR MATTING IN STRIPS DOWN THE SLOPE OVER THE STRAW. BURY UPPER END IN 6-8 INCH DEEP AND WIDE TRENCH.. MOST NETTING COMES IN 14 TO 17 FT. WIDE ROLLS.

B. SECURE THE UPPER END WITH STAKES EVERY 2 FEET.

C. OVERLAP SEAMS ON EACH SIDE 4-5 INCHES.

D. SECURE SEAMS WITH STAKES EVERY 5 FEET.

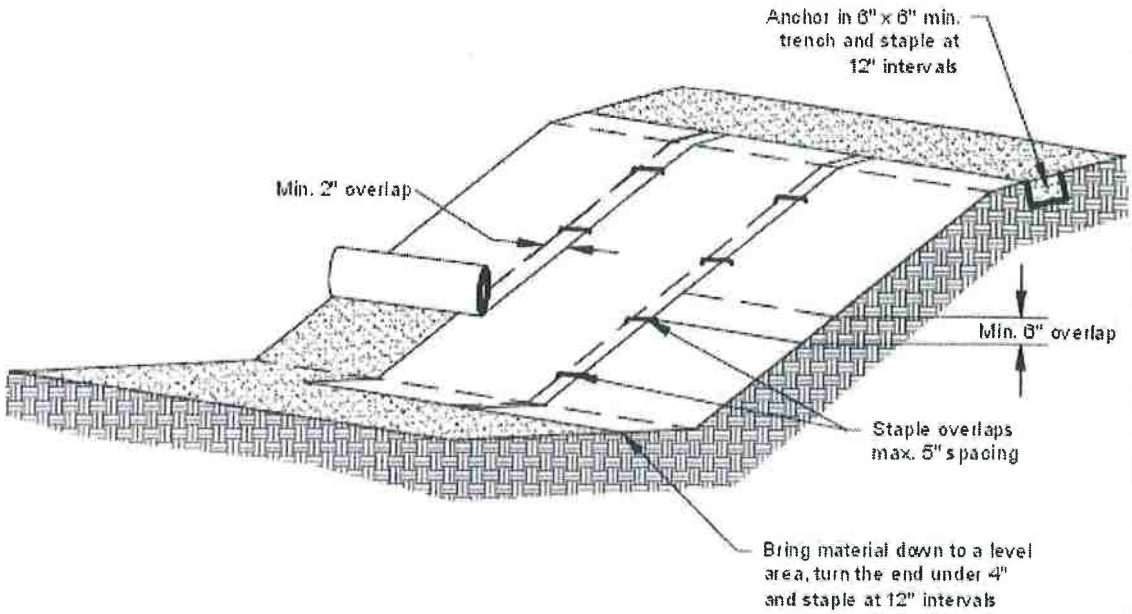
E. STAKE DOWN THE CENTER EVERY 5 FEET.

F. STAKE MIDDLES TO CREATE DIAMOND PAT TERN THAT PROVIDES STAKES SPACED 4-5 FEET APART.

G. USE POINTED 1X2 INCH STAKES 8 TO 9 INCHES LONG. LEAVE 1 TO 2 INCH TOP ABOVE NETTING, OR USE "U" SHAPED METAL PINS AT LEAST 9 INCHES LONG.

NOTE: WHEN JOINING TWO STRIPS, OVERLAP UPPER STRIP 3 FEET OVER LOWER STRIP AND SECURE WITH STAKES EVERY 2 FEET LIKE IN "B" ABOVE

BMP: General Erosion Control (Cont.)



Notes:

1. Slope surface shall be smooth before placement for proper soil contact.
2. Stapling pattern as per manufacturer's recommendations.
3. Do not stretch blankets/mattings tight - allow the rolls to mold to any irregularities.
4. For slopes less than 3H:1V, rolls may be placed in horizontal strips.
5. If there is a berm at the top of the slope, anchor upslope of the berm.
6. Lime, fertilize, and seed before installation. Planting of shrubs, trees, etc. should occur after installation.

NOT TO SCALE

DEPARTMENT OF ECOLOGY
State of Washington

Slope Installation

Revised June 2016

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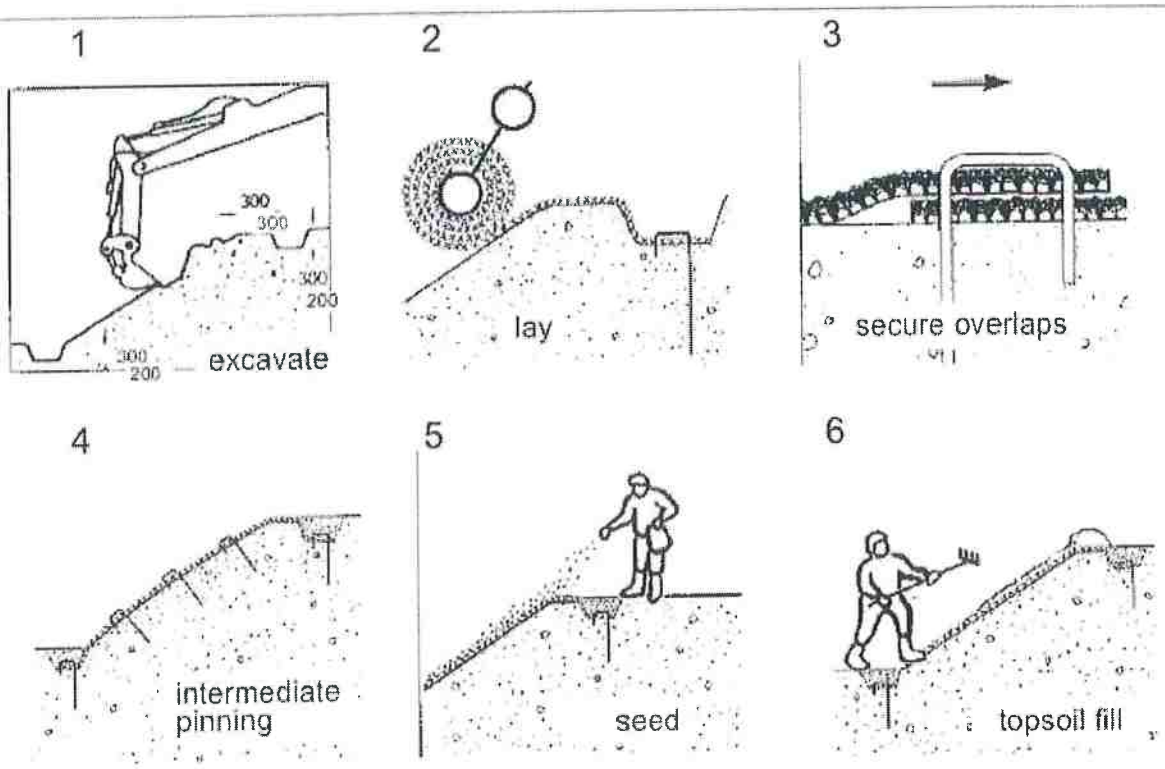
BMP: General Erosion Control (Cont.)

Installation of a geosynthetics mat - Enkamat



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BMP: General Erosion Control (Cont.)

TABLE 34. Guidelines for erosion and sediment control application

Timing of application	Technique	Portion of road and construction area treated
Erosion control during construction	Hydromulching, hydroseeding	Road fill slopes, cut slopes, bare soil areas
	Dry seeding	Road fill slopes, cut slopes, bare soil areas
	Wood chip, straw, Excelsior or tackified mulch	Road fill slopes, cut slopes, bare soil areas
	Straw wattles	Road fill slopes and cut slopes
	Gravel surfacing	Road, landing and turnout surfaces
	Dust palliative	Road surfaces
	Minimize disturbance (soil and vegetation)	All areas peripheral to construction
Sediment control during construction	Sediment basin	Roadside ditches, turnouts and small stream crossings
	Sediment traps (e.g., silt fences, straw bales barriers, woody debris barriers)	Road fill slopes, cutbanks, bare soil areas and ditches
	Straw bale dams	Ditches and small streams
	Sumps and water pumps	Stream channels and stream crossings
	Streamflow diversions (e.g., temporary culverts, flex pipe, etc.)	Stream channels and stream crossings
	Surface diversion and dispersion devices (pipes, ditches, etc.)	All disturbed bare soil areas
Permanent erosion control	Road shaping	Road and landing surfaces
	Gravel surfacing	Road, landing and turnout surfaces
	Bituminous or asphalt surfacing	Road surface
	Rolling dips	Road surface
	Ditch relief culverts	Roadbed and road fill
	Downspouts and berm drains	Road fill slopes
	Waterbars	Road and landing surfaces
	Berms	Road surface and roadside areas
	Ditches	Road and landing surfaces
	Riprap	Road fill slopes, stream crossing fills, cutbanks, stream and lake banks
	Soil bioengineering	Road fill slopes, cut slopes, stream crossings, streambanks
	Tree planting	Road fill slopes, cutbanks, bare soil areas, stream crossings, streambanks

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Permanent Culvert Crossing

- New culvert installations shall be sized to accommodate flows associated with a 100-year storm event.
- If the new culvert is replacing a poorly installed old culvert, the crossing may need to be abandoned to the following standard:
  - When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade and orientation, and that is wider than the natural channel.
  - Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- New culverts shall be placed at stream gradient, or have downspouts, or have energy dissipaters at outfall.
  - Align culverts with the natural stream channel orientation to ensure proper function, prevent bank erosion, and minimize debris plugging. See Figure 97 below.
  - Place culverts at the base of the fill and at the grade of the original streambed or install a downspout past the base of the fill. Downspouts should only be installed if there are no other options.
  - Culverts should be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
  - Culvert beds should be composed of rock-free soil or gravel, evenly distributed under the length of the pipe.
  - Compact the base and sidewall material before placing the pipe in its bed.
  - Lay the pipe on a well-compacted base. Poor basal compaction will cause settling or deflection in the pipe and can result in separation at a coupling or rupture in the pipe wall.
  - Backfill material should be free of rocks, limbs, or other debris that could dent or puncture the pipe or allow water to seep around the pipe.
  - Cover one end of the culvert pipe, then the other end. Once the ends are secure, cover the center.
  - Tamp and compact backfill material throughout the entire process, using water as necessary for compaction.
  - Backfill compacting will be done in 0.5 – 1.0 foot lifts until 1/3 of the diameter of the culvert has been covered.
  - Push layers of fill over the crossing to achieve the final design road grade, road fill above the culvert should be no less than one-third to one-half the culvert diameter at any point on the drivable surface.
- Critical dips shall be installed on culvert crossings to eliminate diversion potential. Refer to Figure 84 below.
- Road approaches to crossings shall be treated out to the first drainage structure (i.e. waterbar, rolling dip, or hydrologic divide) to prevent transport of sediment.
- Road surfaces and ditches shall be disconnected from streams and stream crossings to the greatest extent feasible. Ditches and road surfaces that cannot be feasible disconnected from streams or stream crossings shall be treated to reduce sediment transport to streams.
- If downspouts are used, they shall be secured to the culvert outlet and shall be secure on fill slopes.
- Culverts shall be long enough so that road fill does not extend or slough past the culvert ends.
- Inlet of culverts, and associate fill, shall be protected with appropriate measures that extend at least as high as the top of the culvert.
- Outlet of culverts shall be armored with rock if road fill sloughing into channel can occur.
- Armor inlets and outlets with rock, or mulch and seed with grass as needed (not all stream crossings need to be armored).
- Where debris loads could endanger the crossing, a debris catchment structure shall be constructed upstream of the culvert inlet.
- Bank and channel armoring may occur, when appropriate, to provide channel and bank stabilization.

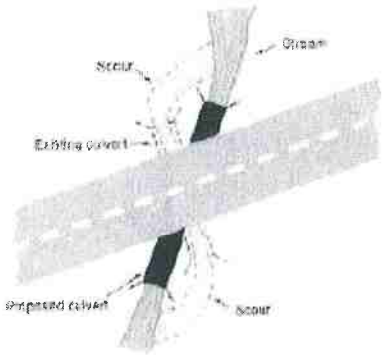
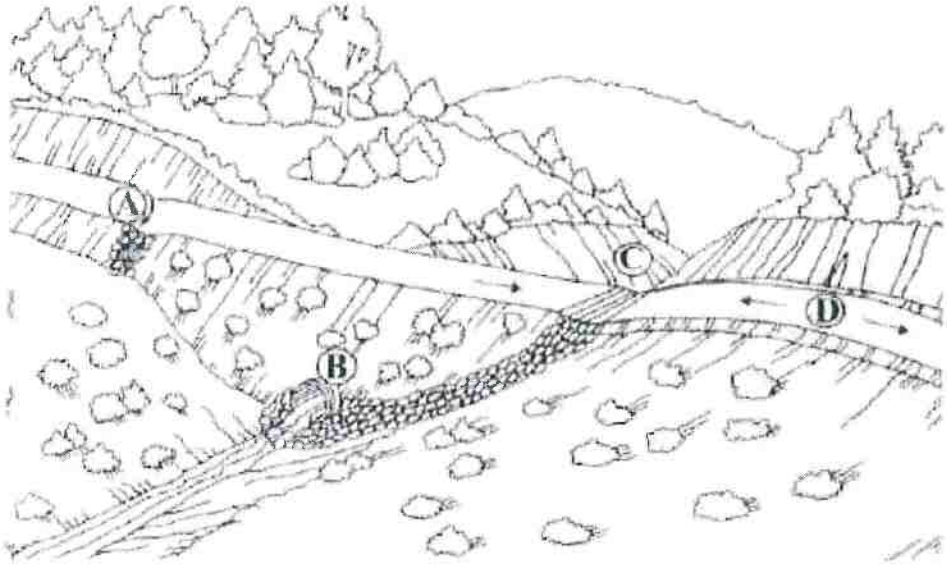


FIGURE 97. *Culvert alignment should be in relation to the stream and not the road. It is important that the stream enters and leaves the culvert in a relatively straight horizontal alignment so streamflow does not have to turn to enter the inlet or discharge into a bank as it exits. This figure shows a redesigned culvert installation that replaces the bending alignment that previously existed. Channel turns at the inlet increase plugging potential because wood going through the turn will not align with the inlet. Similarly, channel turns at the inlet and outlet are often accompanied by scour against the channel banks (Wisconsin Transportation Information Center, 2004).*

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Permanent Culvert Crossing Design (Critical Dip and Hydrologic Disconnect Placement)



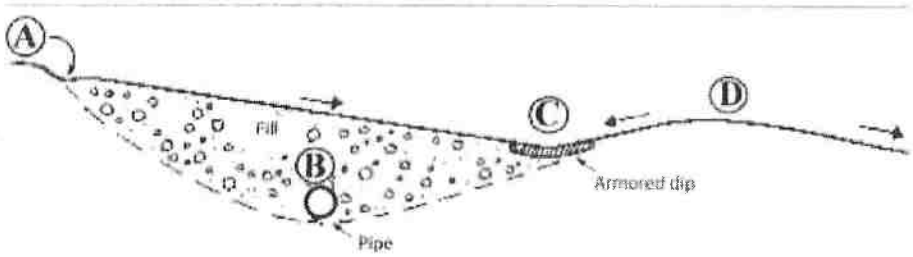
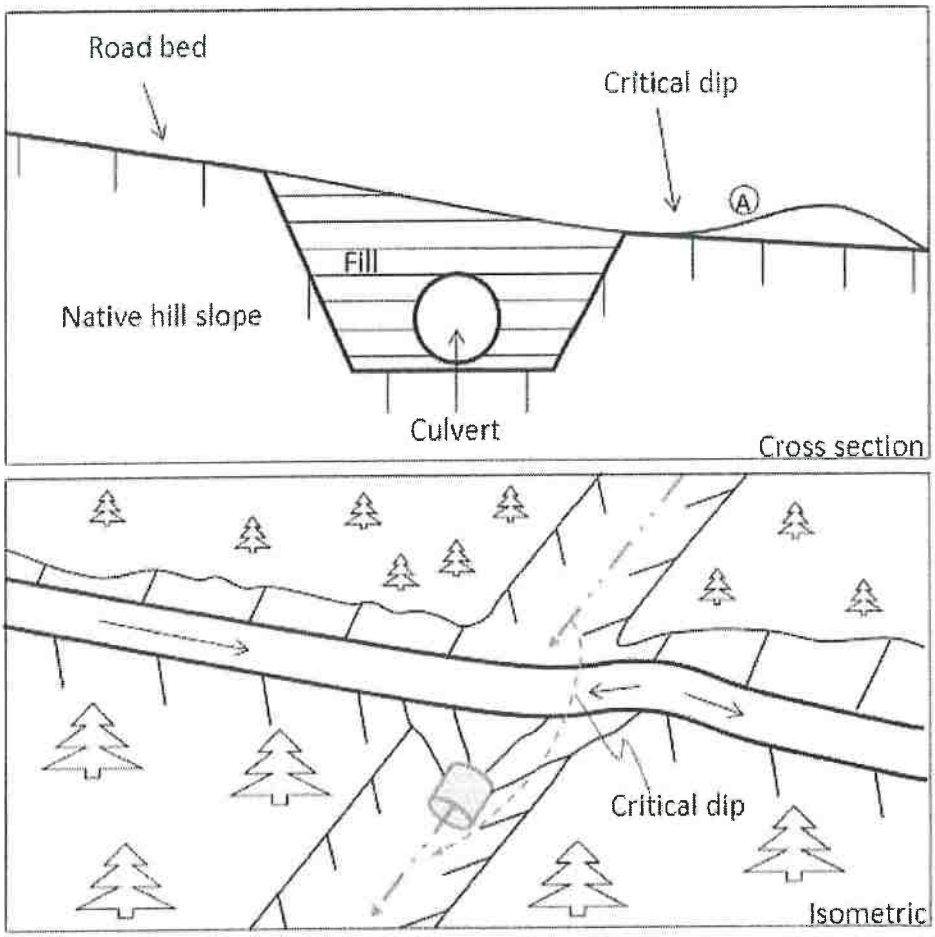


FIGURE 84. *Critical dips or dipped crossing fills should be centered near a stream crossing's down-road hingeline, not over the centerline of the crossing where overtopping could cause washout or severe erosion of the fill. If the stream crossing culvert (B) plugs, water will pond behind the fill until reaching the critical dip or low point in the crossing (C) and flowing back down into the natural stream channel. The down-road ditch must be plugged to prevent streamflow from diverting down the ditch line. For extra protection in this sketch, riprap armor has been placed at the critical dip outfall and extending downslope to the stream channel. This is only required or suggested on stream crossings where the culvert is highly likely to plug and the crossing fill overtopped. The dip at the hinge line is usually sufficient to limit erosional damage during an overtopping event. Road surface and ditch runoff is disconnected from the stream crossing by installing a rolling dip and ditch relief culvert just up-road from the crossing (A) (Keller and Sherar, 2003).*

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Permanent Culvert Crossing Design (Critical Dip)

Typical Critical Dip Design for Stream Crossings with Diversion Potential



Critical Dip Construction:

1. Critical dip will be constructed on the lower side of crossing.
2. Critical dip will extend from the cutbank to the outside edge of the road surface. Be sure to fill inboard ditch, if present.
3. Critical dip will have a reverse grade (A) from cutbank to outside edge of road to ensure flow will not divert outside of crossing.
4. The rise in the reverse grade will be carried for about 10 to 20 feet and then return to original slope.
5. The transition from axis of bottom, through rising grade, to falling grade, will be in the road distance of at least 15 to 30 feet.
6. Critical dips are usually built perpendicular to the road surface to ensure that flow is directed back into the stream channel.

BMP: Permanent Culvert Crossing Design (Culvert Orientation)

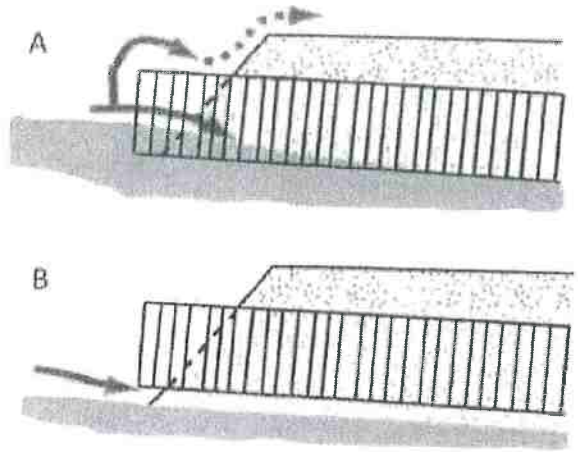
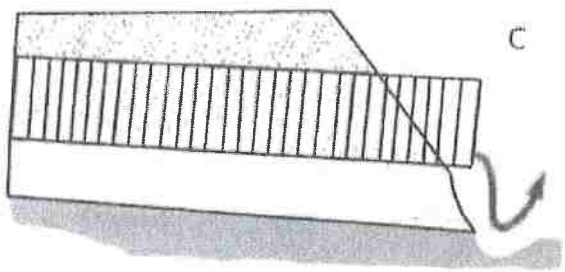
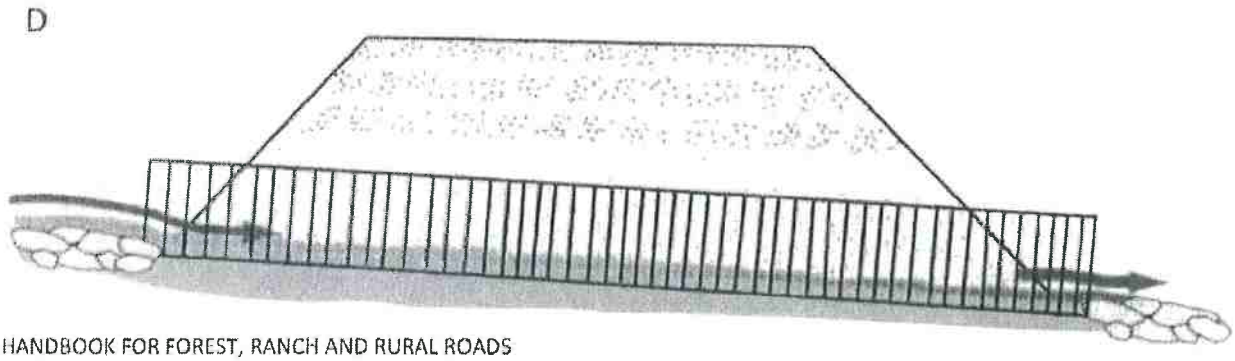


FIGURE 155. *Proper culvert installation involves correct culvert orientation, setting the pipe slightly below the bed of the original stream, and backfilling and compacting the fill as it is placed over the culvert. Installing the inlet too low in the stream (A) can lead to culvert plugging, yet if set too high (B) flow can undercut the inlet. If the culvert is placed too high in the fill (C), flow at the outfall will erode the fill. Placed correctly (D), the culvert is set slightly below the original stream grade and protected with armor at the inlet and outlet. Culverts installed in fish-bearing stream channels must be inset into the streambed sufficiently (>25% embedded) to have a natural gravel bottom throughout the culvert (Modified from: MDSL, 1991).*





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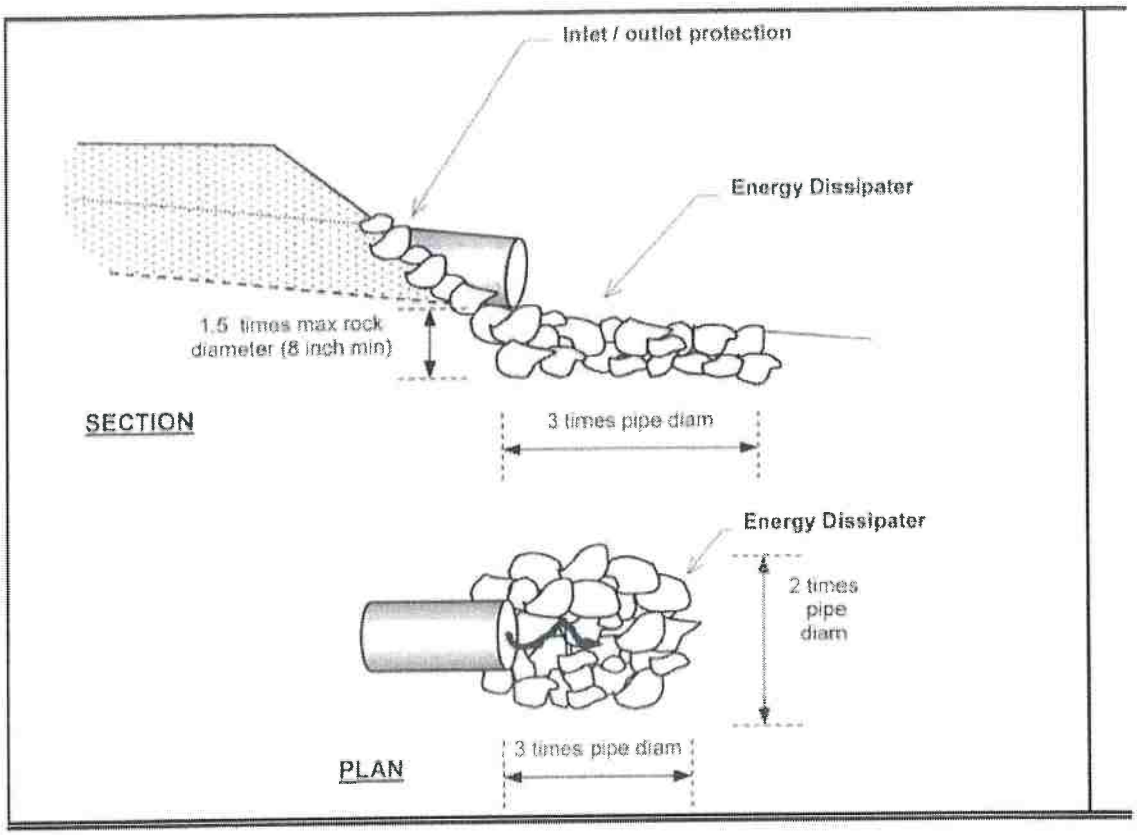
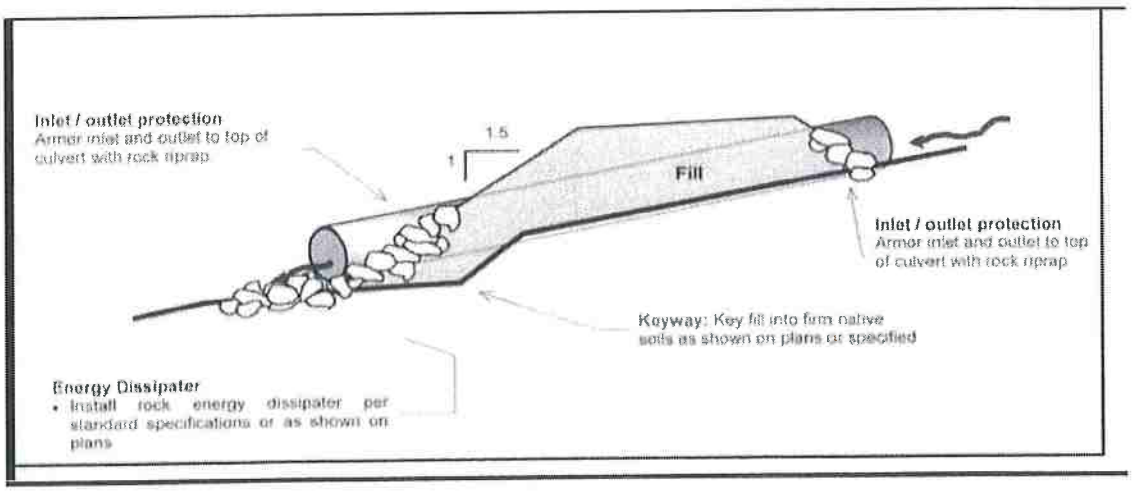
BMP: Permanent Culvert Crossing Design (Inlet and Outlet Armoring)





Riprap installed to protect the inlet and outlet of a stream crossing culvert from erosion or for energy dissipation should be keyed into the natural channel bed and banks to an approximate depth of about 1.5x the maximum rock thickness. Riprap should be placed at least up to the top of the culvert at both the inlet and outlet to protect them from splash erosion and to trap any sediment eroded from the newly constructed fill slope above.

BMP: Permanent Culvert Crossing Design (Inlet and Outlet Armoring) Cont.

- Inlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert.
- Outlets of culverts shall be provided a rocked energy dissipater at the outfall of the culvert.
- Outlets of culverts and associate fills shall be protected with rock armoring that extends at least as high as the top of the culvert if road fill sloughing into channel can occur.
- Prior to inlet and outlet rocking, the inlet and outlets shall be prepared. Preparation will include removal of vegetation and stored materials from the inlet and outlet.
- Inlets may require construction of an inlet basin.
- Slopes at the outlet should be shaped to a 2:1 or natural slope prior to placing rock armor.
- Rock used at culvert inlets and outlets should be a matrix of various sized rocks and rip-rap that range from a 3" dia. to a 2' dia.
- The largest rocks should be places at the base of the culvert or fill. Incrementally smaller rocks shall be placed over the larger rocks at the armoring extend up the slope. Voids and spaces shall be back filed with smaller gravels and rocks.

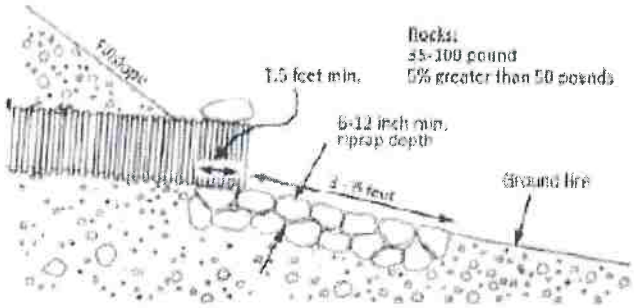


FIGURE 107A. *Riprap armor at culvert outlet (Modified from: Keller et al. 2011).*

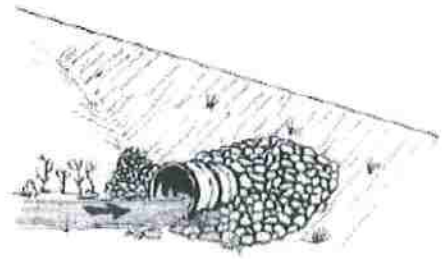


FIGURE 107B. *Riprap armor at culvert inlet (Keller and Sherar, 2003).*

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Stream Bank Armoring (Riprap)

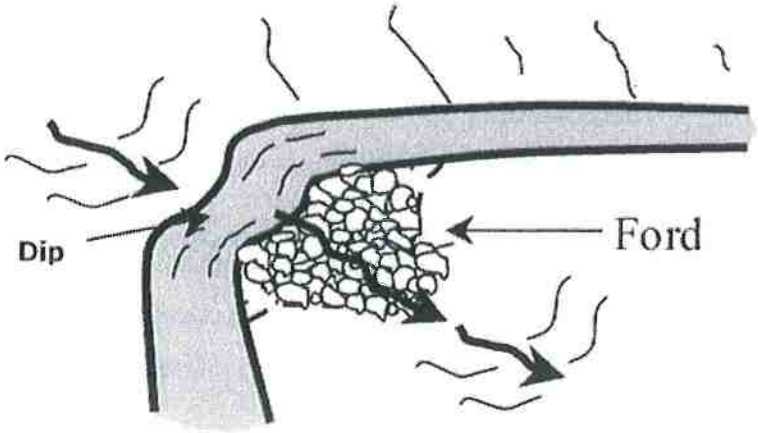
- Riprap should be installed on top of geotextile fabric or a clean mixture of coarse gravel and sand.
- The riprap should be keyed into the streambed and extend below the maximum expected scour depth with an adequately sized key base width at a thickness of a minimum of 2x the median (D50) rock diameter with the largest stone sizes placed at the base of the riprap structure.
- The armor should be set into the streambank so it does not significantly protrude into, or constrict, the natural channel, or otherwise reduce channel capacity.
- The riprap should extend along the length of unstable or over steepened bank and up the bank sufficiently to encompass the existing bank instability and/or design flood elevations.

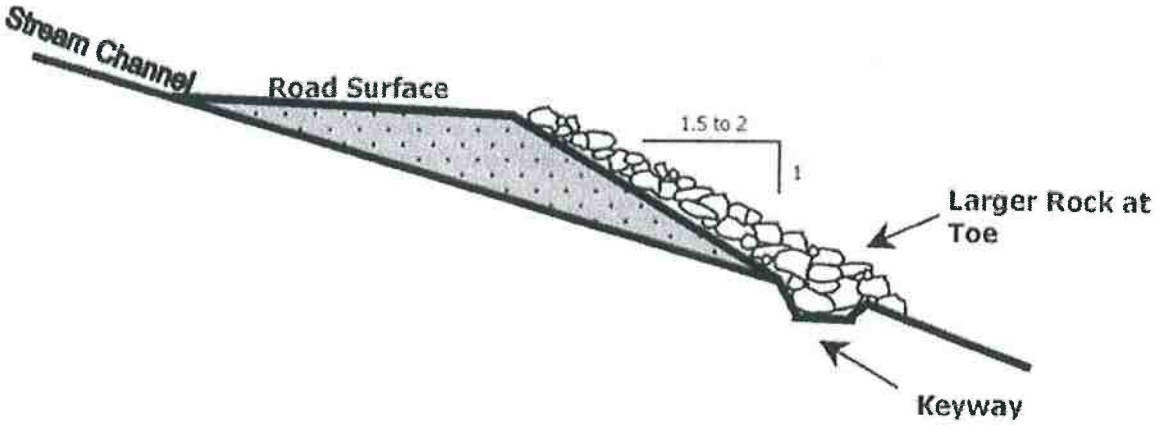
BMP: Rocked Ford

- Rocked fords are drainage structures designed to carry watercourses across roads where culvert crossings are not feasible or un-necessary.
- In channel constructed fords shall be of appropriate material that shall withstand erosion by expected velocities and placed in a U-shaped channel to create a drivable crossing.
  - The road shall dip into and out of the rocked ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the ford shall be constructed with clean rock. The rock shall be applied to a minimum depth of 6 inches.
  - A range of interlocking rock armor sizes should be selected and sized so that peak flows will not pluck or transport the armor off the roadbed or the sloping fill face of the armored fill.
- The ford's outlet shall be rock armored to resist downcutting and erosion.
  - *Excavate the keyway and armored area* - Excavate a two to three-foot-deep "bed" into the dipped road surface and adjacent fillslope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
  - *Armor the basal keyway* - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
  - *Armor the fill* - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
  - *Armor the top of the fill* - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- If water is expected during the time of use, an adequately sized pipe shall be installed to handle the flow if present (min. 6 inch).
  - The pipe shall be laid over the rocked ford surface.
  - The inlet should be at grade with the upstream flow.
  - The outlet shall drain onto the outlet armoring of the rocked ford.
  - A layer of clean rock/gravel shall be installed over the pipe to establish the running surface of the truck road.
  - Following use, the temporary pipe shall be removed and the placed rock/gravel shall be graded out of the ford and used on the approaches.
  - No significant alteration to the bed and bank of the stream shall occur.
- Road approaches to rocked fords shall be rock surfaced out to the first drainage structure (i.e. waterbar) or hydrologic divide to prevent transport of sediment using rock.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Road approach rock and rock ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

BMP: Rocked Ford (Cont.)

FORD: A large dip is graded into the road at the axis of the stream channel. The outside fill face is dished out to form a spillway with large rock. On large watercourses, rock is keyed several feet into firm native soils. The road surface is rocked with 6" of minus rock .





BMP: Armored Ford [Fill]

- Armored fords are drainage structures designed to carry watercourses across roads.
- Armored fords shall have a U-shaped channel to create a drivable crossing.
  - The road shall dip into and out of the armored ford to minimize diversion potential. Construct a broad rolling dip across the roadbed, centered at the crossing, which is large enough to contain the expected 100-yr flood discharge while preventing flood flow from diverting down the road or around the rock armor.
- The road surface at the armored ford shall utilize native soils.
- The ford's inlet shall be rocked if a threat of head cutting exists.
  - *Excavate the keyway* - Excavate a one to three-foot-deep "bed" into the inboard edge of the road
  - *Armor the basal keyway* – place various sized rock in the constructed keyway to prevent head cutting. Use the largest rock armor to fill the keyway trench and create a buttress along the inboard edge of the road. This should have a "U" shape to it and it will define the inlet where flow leaves the natural channel and enters the road.
- The ford's outlet shall be rock armored to resist downcutting and erosion.
  - *Excavate the keyway and armored area* - Excavate a two to three-foot-deep "bed" into the dipped road surface and adjacent fillslope (to place the rock in) that extends from approximately the middle of the road, across the outer half of the road, and down the outboard road fill to where the base of the fill meets the natural channel. At the base of the fill, excavate a keyway trench extending across the channel bed.
  - *Armor the basal keyway* - Put aside the largest rock armoring to create the buttresses. Use the largest rock armor to fill the basal trench and create a buttress at the base of the fill. This should have a "U" shape to it and it will define the outlet where flow leaves the armored fill and enters the natural channel.
  - *Armor the fill* - Backfill the fill face with the remaining rock armor making sure the final armor is unsorted and well placed, the armor is two coarse-rock layers in thickness, and the armored area on the fill face also has a "U" shape that will accommodate the largest expected flow.
  - *Armor the top of the fill* - Install a second trenched buttress for large rock at the break-in-slope between the outboard road edge and the top of the fill face.
- If water is expected during the time of use, an adequately sized pipe shall be installed to handle the flow if present (min. 6 inch).
  - The pipe shall be laid over the armored ford surface.
  - The inlet should be at grade with the upstream flow.
  - The outlet shall drain onto the outlet armoring of the rocked ford.
  - A layer of clean native shall be installed over the pipe to establish the running surface of the truck road.
  - Following use, the temporary pipe shall be removed and the placed native soil shall be removed and drifted along the approaches.
  - No significant alteration to the bed and bank of the stream shall occur.
- Road approaches to armored fords shall be treated with seed and straw mulch out to the first drainage structure (i.e. waterbar) or hydrologic divide to prevent transport of sediment pursuant to Item 18, Section II.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.
- Armored ford armoring shall be reapplied following use as needed to maintain a permanent crossing.

BMP: Armored Ford [Fill] (Cont.)

FIGURE 120. *This armored fill crossing of a steep, ephemeral stream was constructed to provide a low maintenance crossing. The crossing has been deeply dipped to reduce the volume of road fill and to eliminate the potential for stream diversion. The fill slope has been heavily armored through the axis of the crossing to contain flood flows and prevent down-cutting. Armored fills cannot be used on fish bearing streams.*

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BMP: Armored Ford [Fill] (Cont.)

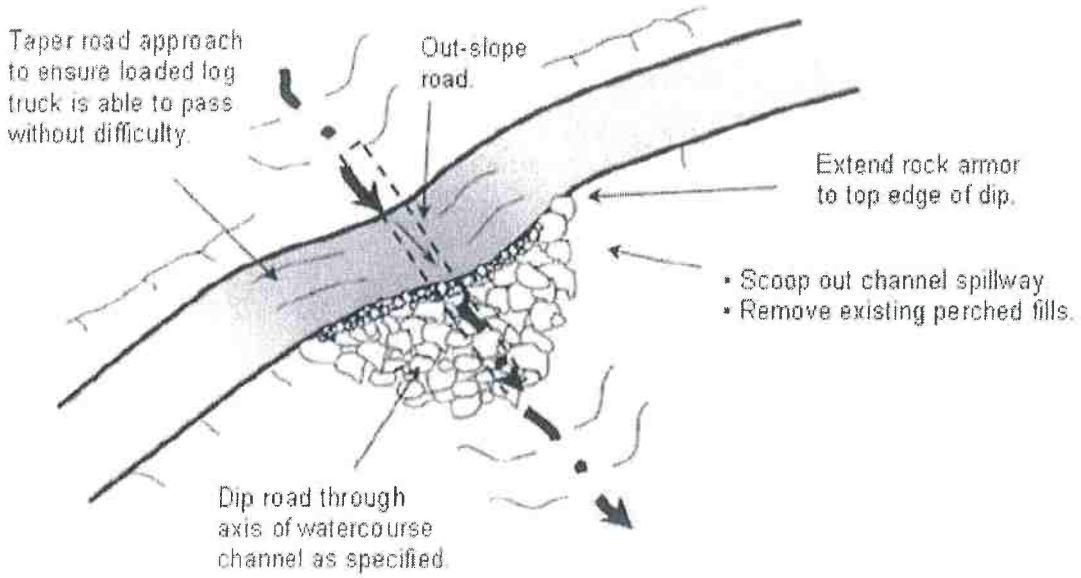
FIGURE 121D. *Well graded rock armor is then backfilled into the structure and spread across the breadth of the U-shaped stream crossing, and about one-third the way up the roadbed, so that streamflow will only flow over or come in contact with resistant armor material. The armor must be spread and compacted across the design width of the expected flood flow channel width so peak flows will not flank the armored structure*

FIGURE 121E. *Two weeks after this armored fill was constructed, a storm flow event occurred and the structure maintained its function and integrity. The road approaches had not yet been compacted or surfaced with road rock.*

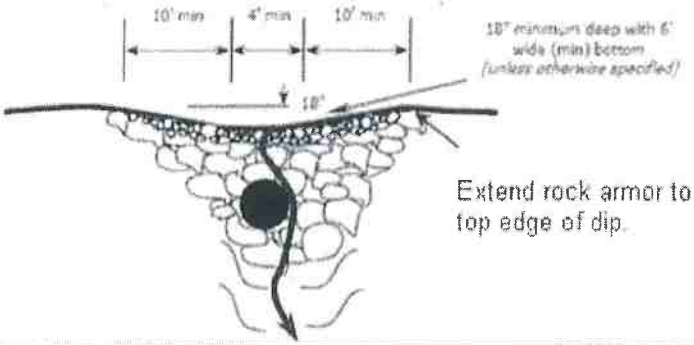
FIGURE 121F. *The same armored fill as it appeared after the first winter flood flows. No maintenance was required to reopen the road. It is also clear that no stream diversion is possible at this stream crossing site, and the volume of fill within the crossing has been reduced to the minimum amount needed to maintain a relatively smooth driving surface on this low volume road.*

BMP: Vented Ford

Vented Ford



Dip area to accommodate a culvert sized for 100-year flow (minimum dimensions given below).



LIP

- Use smaller rock at lip of ford.
- Fill voids with smaller rock to prevent piping around the larger rock.

BMP: Crossing Abandonment

- When fills are removed they shall be excavated to form a channel that is as close as feasible to natural watercourse grade and orientation, and that is wider than the natural channel.
- Excavated banks shall be laid back to a 2:1 (50%) or natural slope.
- Temporary crossings shall be removed by November 15.
  - Any temporary culvert crossing left in after October 15 or installed between October 15 and May 1, shall be sized to accommodate the estimated 100-year flow.
- Bank and channel armoring may occur when appropriate to provide channel and bank stabilization.

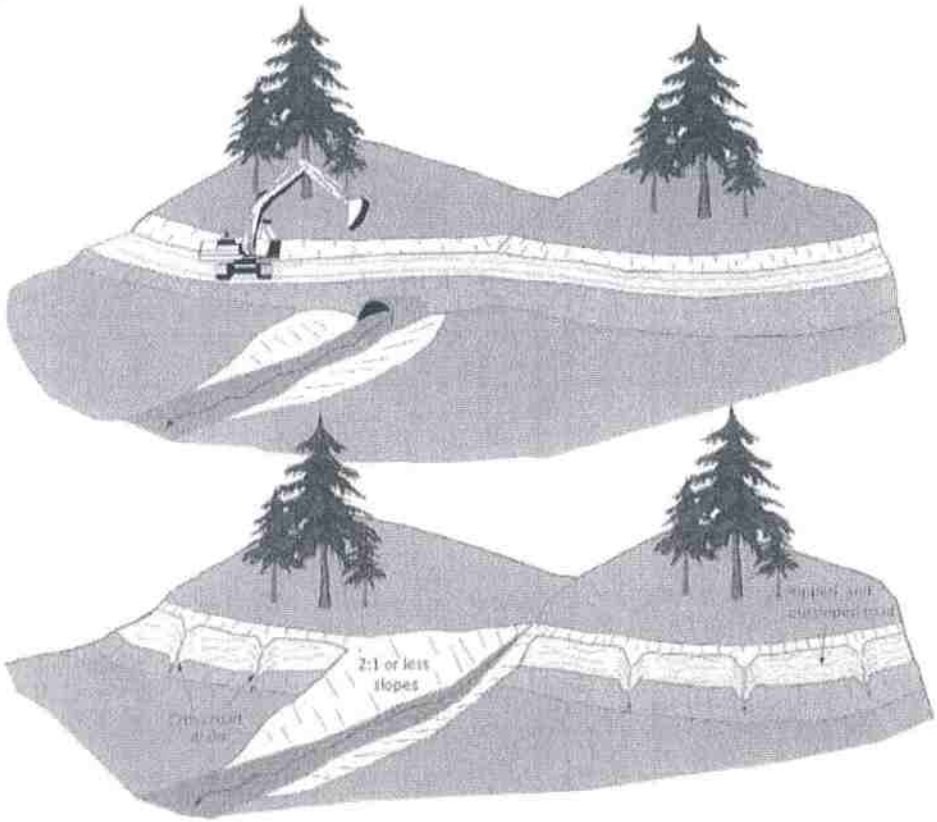


FIGURE 263. *On roads that are to be closed (decommissioned), all stream crossing culverts and fills should be removed. Stream crossing excavations are best performed using an excavator. The original channel should be excavated and exhumed down to the former streambed, with a channel width equal or greater than the natural channel above and below the crossing. Sideslopes should be laid back to a stable angle, typically a 2:1 (50%) gradient, or less. Spoil can be endhauled off-site or stored on the road bench adjacent the crossing, provided it is placed and stabilized where it will not erode or fall and enter the stream.*

BMP: Permanent Crossing Decommissioning (Cont.)

- Excavating and removing all fill materials placed in the stream channel when the crossing was originally built.
- Fill material should be excavated to recreate the original channel grade (slope) and orientation.
- The excavated channel bed should be as wide, or slightly wider than, the original watercourse channel.
  - This can be better determined by observing the channel width of the watercourse up slope of crossing to be removed at a point in which the crossing or any other disturbance has not affected the natural channel slope and width.
- If the channel sideslopes were disturbed, they should be graded (excavated) back to a stable angle (generally less than 50% (2:1)) to prevent slumping and soil movement.
- The bare soils should then be mulched, seeded, and planted to minimize erosion until vegetation can protect the surface.
- The approaching, hydrologically connected road segments should be cross-road drained to prevent road runoff from discharging across the freshly excavated channel sideslopes.

BMP: Rolling Dip Design and Placement

- Rolling dips are drainage structures designed to force surface water to be drained from the road surface.
- The road shall dip into, and rise out of, the rolling dip to eliminate the potential of road surface runoff to run further down road way.
- The rolling dip shall be constructed with clean native materials or rock surfaced where specified.
- The rolling dips outlet may be armored to resist down-cutting and erosion of the outboard road fill.
- Do not discharge rolling dips into any areas that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill in order to force all ditch flows through the trough (low point) of the rolling dip.

BMP: Rocked Rolling Dip Design and Placement

- Rocked rolling dips are drainage structures designed to carry known sources of surface water across road ways or from known persistently wet segments of road such as swales without defined watercourses or road segments with heavy bank/road seepage.
- The road shall dip into, and rise out of, the rocked rolling dip to minimize diversion potential.
- The rocked rolling dip shall be constructed with clean rock that is large enough to remain in place during peak flows. Rock size shall vary relative to the anticipated flow through the dip with larger rock used in location where greater flow is anticipated.
- The rocked rolling dips inlet and outlet shall be armored to resist down-cutting and erosion.
- The entire width of the rocked rolling dip shall be rock armored to a minimum of 5-feet from the centerline of the dipped portion of the rolling dip.
- If a keyway is necessary, the rocked rolling dip keyway at the base of the dip shall be of sufficient size, depth and length to support materials used in the rocked rolling dip construction back up to the road crossing interface.
- Do not discharge rolling dips into any areas that show signs of instability or active landsliding.
- If the rolling dip is designed to divert both road surface and ditch runoff, block the down-road ditch with compacted fill.
- The rolling dip should be designed as a broad feature ranging from 10-100 feet long so that it is drivable by most types of vehicular traffic and not significantly inhibit traffic and road use.

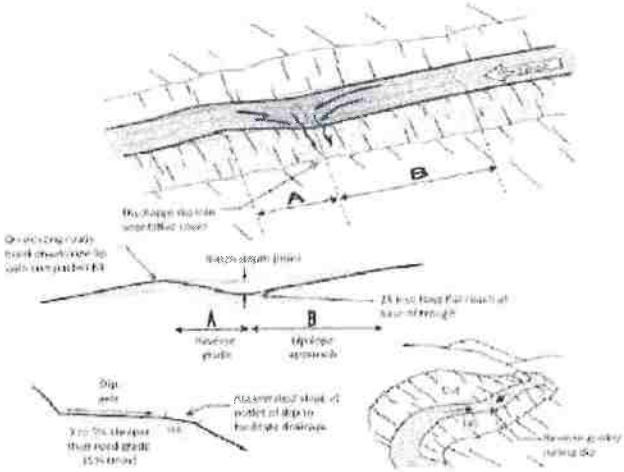


FIGURE 34. *A classic Type I rolling dip, where the excavated up-road approach (B) to the rolling dip is several percent steeper than the approaching road and extends for 60 to 80 feet to the dip axis. The lower side of the structure reverses grade (A) over approximately 15 feet or more, and then falls down to rejoin the original road grade. The dip must be deep enough that it is not obliterated by normal grading, but not so deep that it is difficult to negotiate or a hazard to normal traffic. The outward cross-slope of the dip axis should be 3% to 5% greater than the up-road grade (B) so it will drain properly. The dip axis should be cross-sloped sufficiently to be self-cleaning, without triggering excessive downcutting or sediment deposition in the dip axis (modified from: Best, 2013).*

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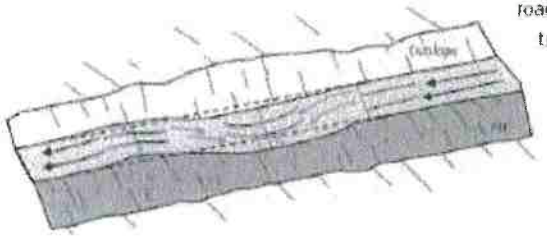
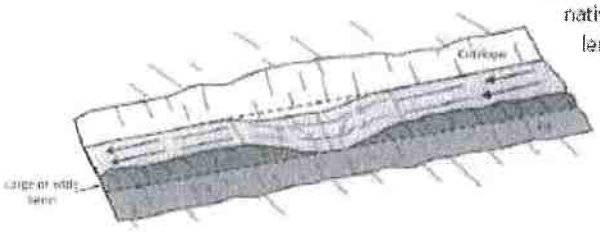
BMP: Rolling Dip Design and Placement (Types)

Type 1 Rolling Dip
(Standard)



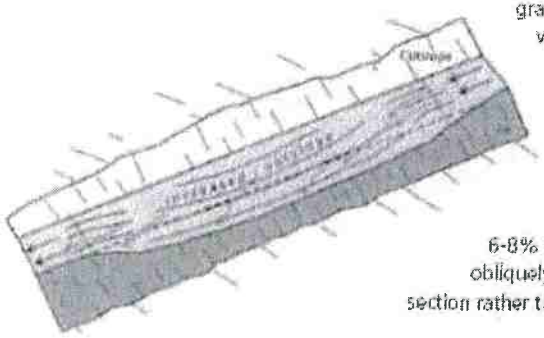
Type 1 rolling dips are used where road grades are less than about 12-14% and road runoff is not confined by a large through cut or berm. The axis of the dip should be perpendicular to the road alignment and sloped at 3-4% across the road tread. Steep roads will have longer and more abrupt dip dimensions to develop reverse grade through the dip axis. The road tread and/or the dip outlet can be rocked to protect against erosion, if needed.

Type 2 Rolling Dip
(Through-cut or thick berm road reaches)



Type 2 rolling dips are constructed on roads up to 12-14% grade where there is a through cut up to 3 feet tall, or a wide or tall berm that otherwise blocks road drainage. The berm or native through cut material should be removed for the length of the dip, or at least through the axis of the dip, to the extent needed to provide for uninterrupted drainage onto the adjacent slope. The berm and slope material can be excavated and endhauled, or the material can be sidecast onto native slopes up to 45%, provided it will not enter a stream.

Type 3 Rolling Dip
(Steep road grade)



Type 3 rolling dips are utilized where road grades are steeper than about 12% and it is not feasible to develop a reverse grade that will also allow passage of the design vehicle (steep road grades require more abrupt grade reversals that some vehicles may not be able to traverse without bottoming out).

Instead of relying on the dip's grade reversal to turn runoff off the roadbed, the road is built with an exaggerated outslope of 6-8% across the dip axis. Road runoff is deflected obliquely across the dip axis and is shed off the outsloped section rather than continuing down the steep road grade.

FIGURE 36. *Rolling dip types*

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BMP: Rolling Dip Design and Placement

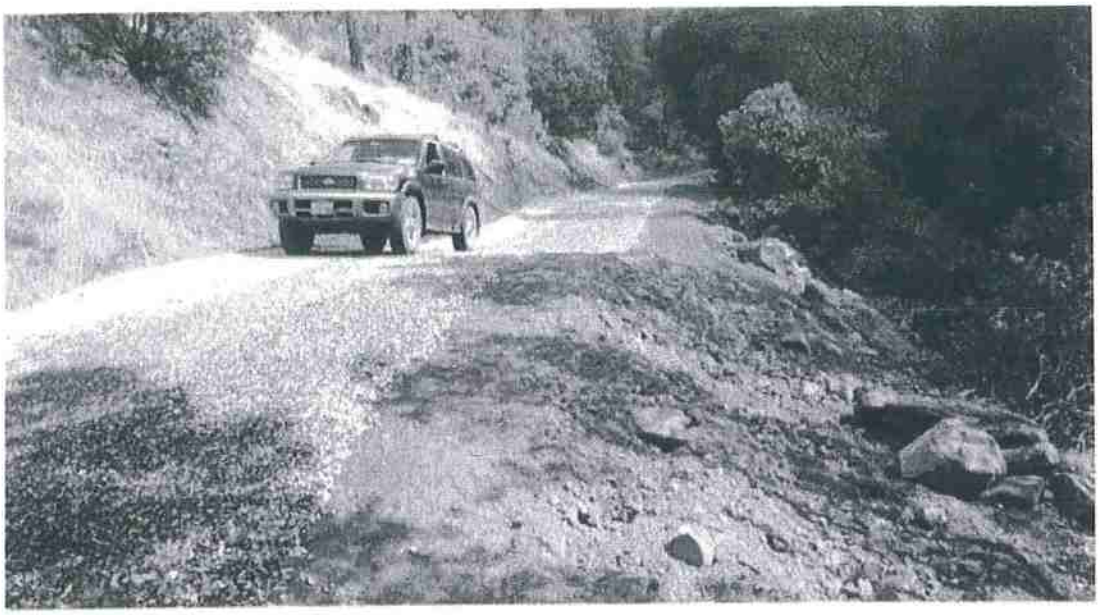

FIGURE 33A. *Rolling dip constructed on a rock surfaced rural road. The rolling dip represents a change-in-grade along the road alignment and acts to discharge water that has collected on, or is flowing down, the road surface. This road was recently converted from a high maintenance, insloped, ditched road to a low maintenance, outsloped road with rolling dips.*

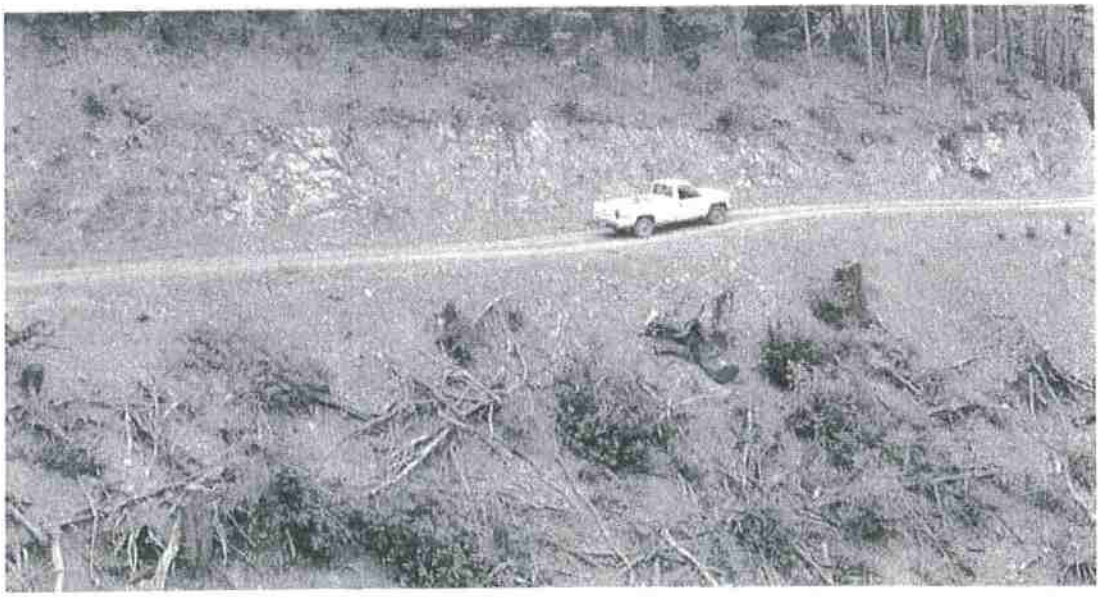

FIGURE 33B. *This side view of an outsloped road shows that the rolling dip does not have to be deep or abrupt to reverse road grade and effectively drain the road surface. This outsloped forest road has rolling dips that allow all traffic types to travel the route without changing speed.*

BMP: Waterbar/Rolling Dip Combined with DRC

FIGURE 39.
Waterbars are often used to drain surface runoff from seasonal, unsurfaced roads. Because they are easily broken down by vehicles, waterbars are only used on unsurfaced roads where there is little or no wet weather traffic. In this photo, a waterbar and ditch relief culvert are used to drain all road surface and ditch runoff from the insloped road prism.

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Diagram shows and discussed the use of a waterbar. However, a DRC combined with a rolling dip structure provides the same surface and ditch drainage for roads used year-round. Just as with the waterbar in the photo above, The DRC is installed just upslope from the rolling dip. This also creates a fail-safe should the DRC become plugged or overwhelmed.

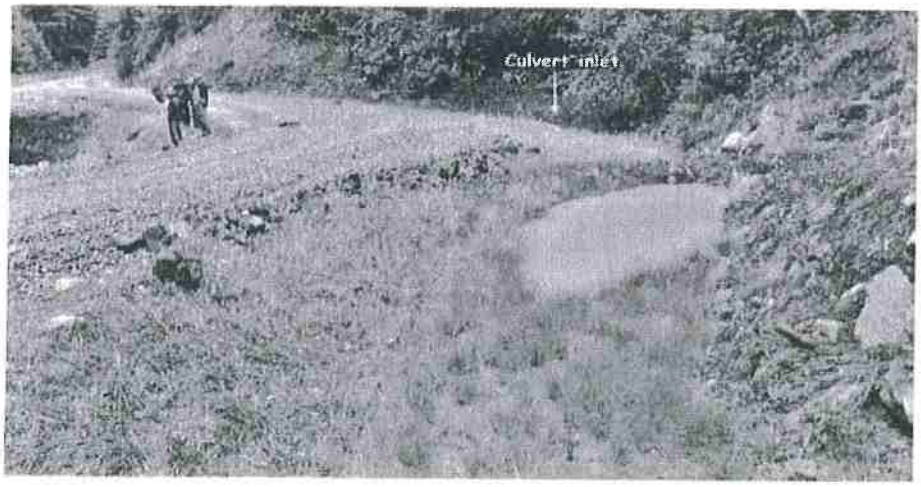

FIGURE 238. *Traffic and surface runoff from graveled roads often produces surface erosion, turbid runoff and fine sediment transport that can be delivered to streams. Where ditches can't be eliminated, sediment traps and roadside settling basins can be installed to capture and remove most of the eroded sediment. This settling basin has been constructed along the inside ditch just before a stream crossing culvert inlet (see arrow). Eroded sediment from the road and ditch are deposited in the basin before flow is released to the stream. Fine sediments have filled about 1/3 of this basin and vegetation is now growing. Sediment basins require periodic maintenance to maintain their storage capacity.*

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BMP: Road Outsloping

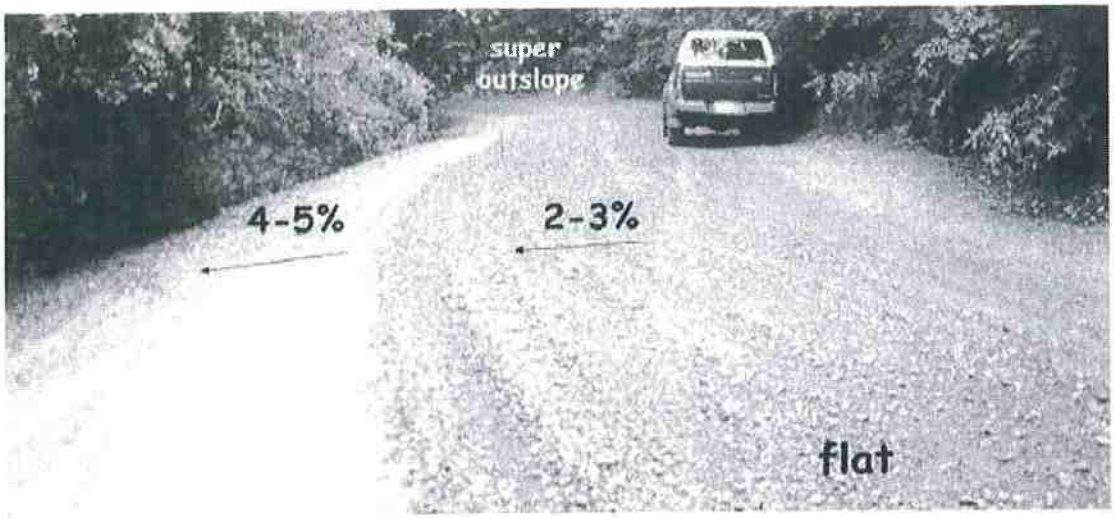

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FIGURE 29. *Road shape changes as the road travels through the landscape. For example, an outsloped road will have a steep or "banked" outslope through inside curves, a consistent outslope through straight reaches and a flat or slightly insloped shape as it goes through an outside curve. The road may have an outslope of 2-3% across the travel surface while the shoulder is more steeply outsloped to ensure runoff and sediment will leave the roadbed.*

BMP: Steep Road Drainage Structures

FIGURE 55. *Steep roads that go straight up or down a hillside are very difficult to drain. This steep, fall line road developed a through cut cross section that was drained using lead out ditches to direct runoff off the road and onto the adjacent, vegetated hillside. The road was "outsloped" to drain runoff to the right side, and the lead out ditch was built slightly steeper than the road grade, to be self-cleaning. Four lead out ditches have been constructed at 100-foot intervals to the bottom of the hillside.*

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BMP: Ditch Relief Culvert

- Install ditch relief culverts at an oblique (typically 30 degree) angle to the road so that ditch flow does not have to make a sharp angle turn to enter the pipe. On low gradient roads (<5%), where ditch flow is slow, ditch relief culverts can be installed at right angles to the road.
- Install ditch relief culverts (DRC) to outlet at, and drain to, the base of the fill
- If it cannot be installed at the base of the fill, install the DRC with a grade steeper than the inboard ditch draining to the culvert inlet, and then install a downspout on the outlet to carry the culverted flow to the base of the fillslope or energy dissipater material at outlet to prevent erosion or the outboard road fill.
- Downspouts longer than 20 feet should be secured to the hillslope for stability.
- Ditch relief culverts should not carry excessive flow such that gullying occurs below the culvert outlet or such that erosion and down-cutting of the inboard ditch is occurring.
- Do not discharge flows from ditch relief culverts onto unstable areas or highly erodible hillslopes.
- If the ditch is on an insloped or crowned road, consider reshaping road outsloping to drain the road surface. The ditch and the ditch relief culvert would then convey only spring flow from the cutbank and hillslope runoff, and not turbid runoff from the road surface.

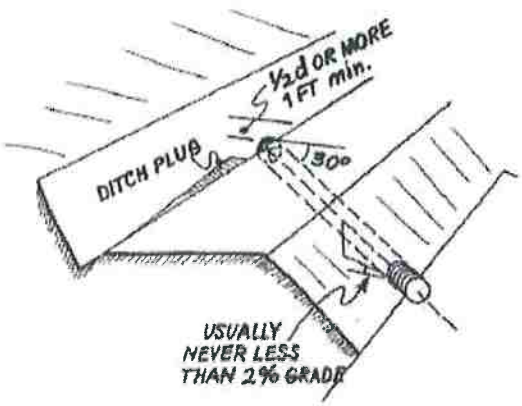
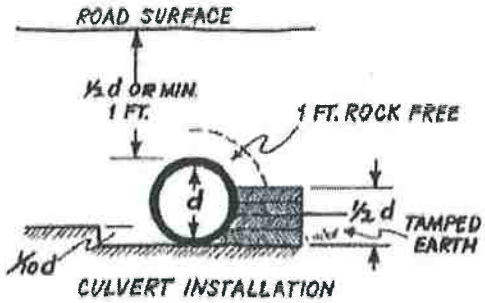


FIGURE 48. *The elements of a properly installed ditch relief culvert. The culvert is angled at about 30 degrees to the road alignment to help capture flow and prevent culvert plugging or erosion of the inlet area. It is set at the base of the fill (ideally) or with a grade slightly steeper than the grade of the contributing ditch (but never with a grade less than 2 percent) (USDA-SCS, 1983). At a minimum, the grade of the ditch relief culvert should be sufficient to prevent sediment accumulation at the inlet or deposition within the culvert itself (it should be self-cleaning) (USDA-SCS, 1983).*



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BMP: Waterbar Construction

FIGURE 40. *Waterbars are constructed on unsurfaced forest and ranch roads that will have little or no traffic during the wet season. The waterbar should be extended to the cutbank to intercept all ditch flow (1) and extend beyond the shoulder of the road. A berm (2) must block and prevent ditch flow from continuing down the road during flood flows. The excavated waterbar (3) should be constructed to be self-cleaning, typically with a 30° skew to the road alignment with the excavated material berned on the downhill grade of the road (4). Water should always be discharged onto the downhill side on a stable slope protected by vegetation. Rock (shown in the figure) should not be necessary if waterbars are spaced close enough to prevent serious erosion. (5) The cross ditch depth (6) and width (7) must allow vehicle cross-over without destroying the function of the drain. Several alternate types of waterbars are possible, including one that drains only the road surface (not the ditch), and one that drains the road surface into the inside ditch (BCMF, 1991).*

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BMP: Unstable Fill Removal and Treatment

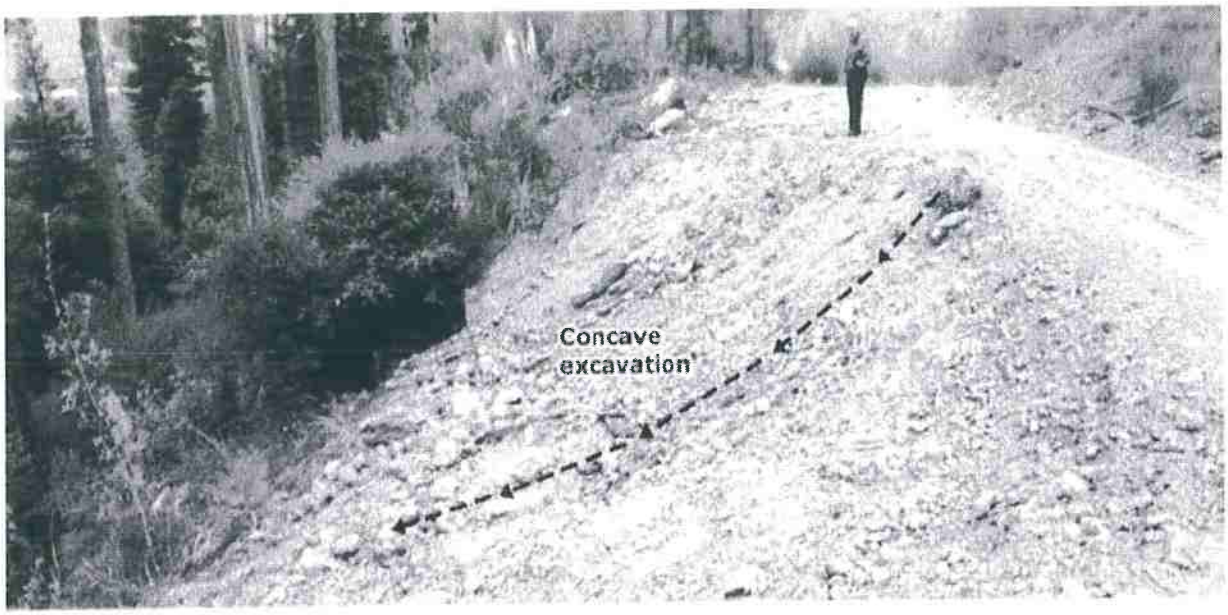
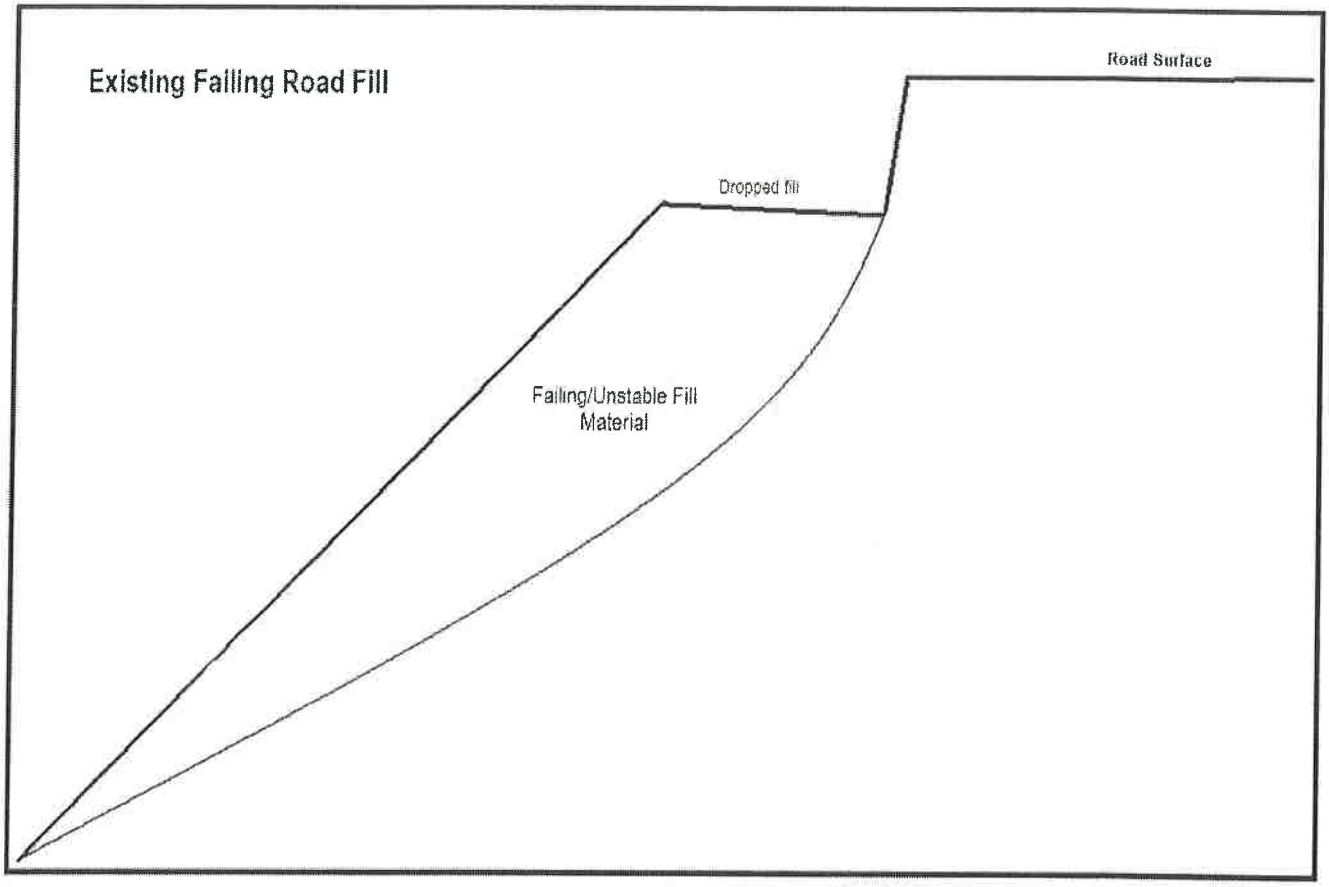
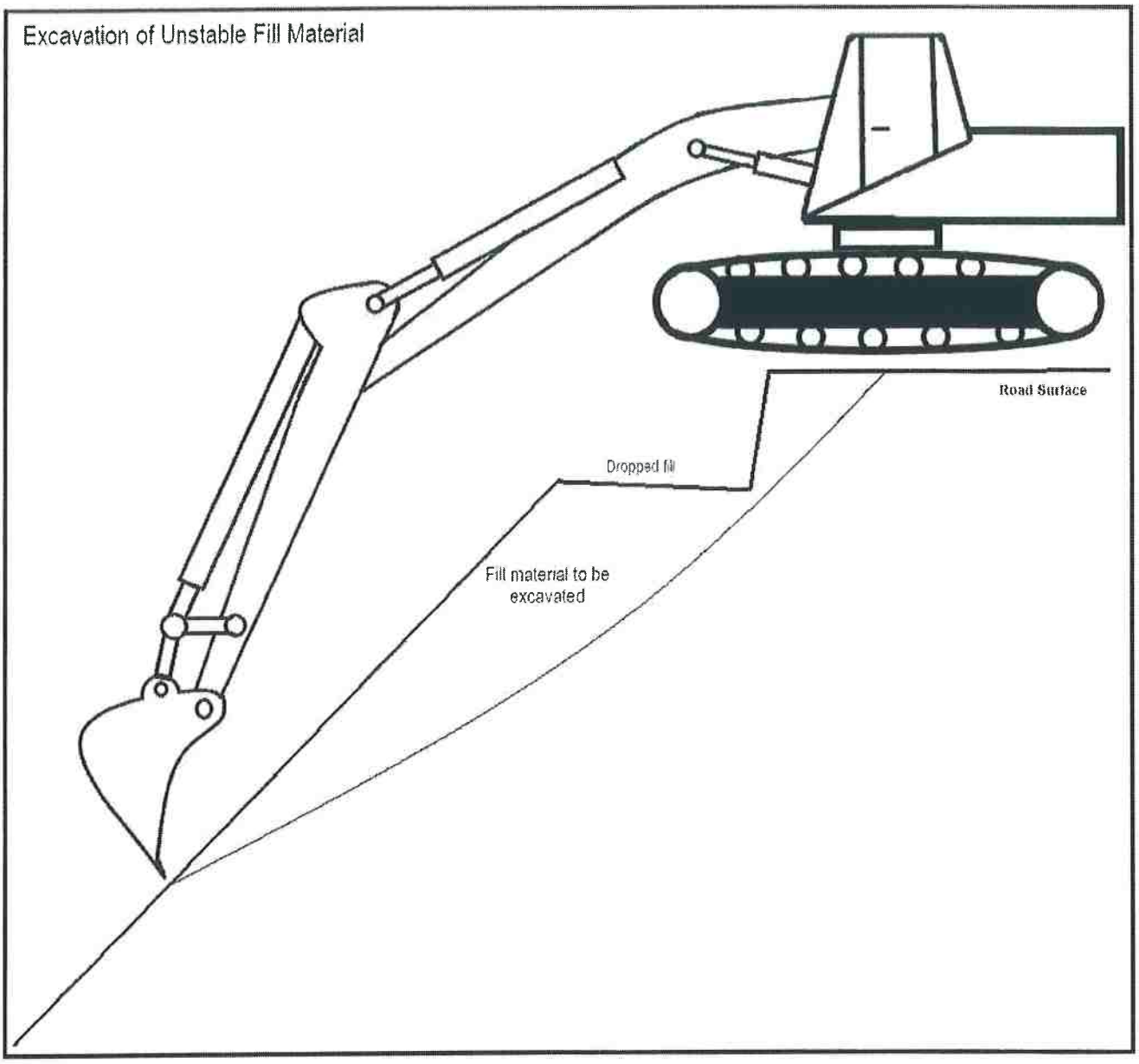


FIGURE 230. *The most cost-effective treatment for unstable fills along the outside of a forest, ranch or rural road is simply the direct excavation of the unstable material. If road width is too narrow, additional width can often be derived from cutting into the bank. The excavation should encompass the unstable fill materials, beginning at the inside crack or scarp, and extending out and down the fill slope as far as possible. For proper surface drainage, and to retrieve most of the unstable fill, the excavation should have a concave profile when completed. Typically, the bulk of the fill is within 20 to 25 feet of the outside edge of the road and is easily reached by a midsized excavator. Any remaining fill is likely to be small enough that it will not fail or travel far enough to reach the stream.*

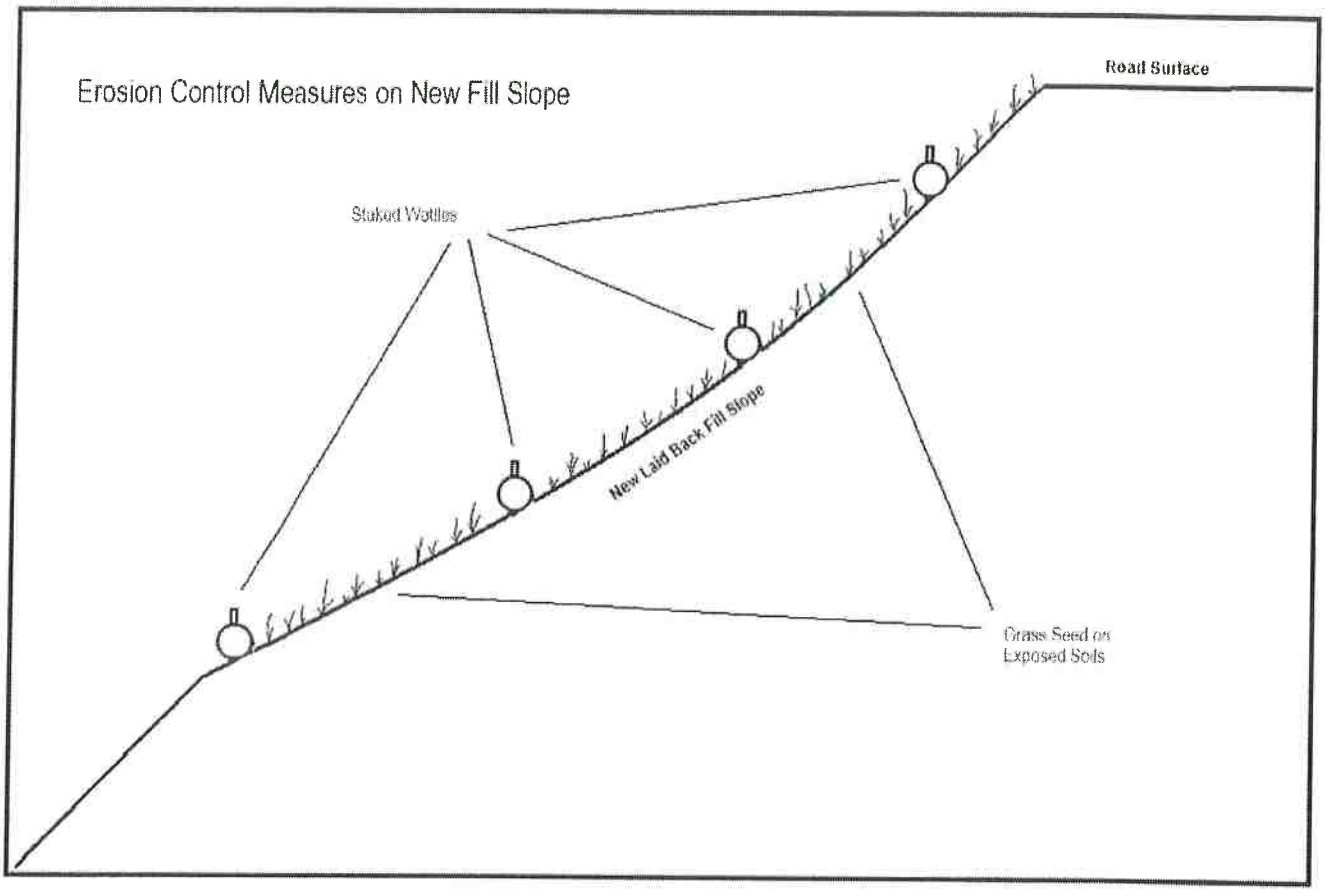
BMP: Unstable Fill Removal and Treatment



BMP: Unstable Fill Removal and Treatment



BMP: Unstable Fill Removal and Treatment



BMP: Rock Armor Cutbank

FIGURE 52. *This wet and potentially unstable cut slope on a newly constructed road was stabilized using a buttress of large rock armor. To assure their effectiveness, rock buttresses and other retaining structures should be designed by a qualified engineer or engineering geologist.*

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Rip-Rap Size Class Table

TABLE 25. Standard classification and gradation of riprap by size of rock[1]

Riprap size class	Median particle weight[2]	Median particle diameter[2] (in)	Minimum and maximum allowable particle size (in)[2]						
			D_{15}		D_{50}		D_{85}		D_{100}
			Min	Max	Min	Max	Min	Max	Max
Class I	20 lb	6	3.7	5.2	5.7	6.9	7.8	9.2	12.0
Class II	60 lb	9	5.5	7.8	8.5	10.5	11.5	14.0	18.0
Class III	150 lb	12	7.3	10.5	11.5	14.0	15.5	18.5	24.0
Class IV	300 lb	15	9.2	13.0	14.5	17.5	19.5	23.0	30.0
Class V	¼ ton	18	11.0	15.5	17.0	20.5	23.5	27.5	36.0
Class VI	3/8 ton	21	13.0	18.5	20.0	24.0	27.5	32.5	42.0
Class VII	½ ton	24	14.5	21.0	23.0	27.5	31.0	37.0	48.0
Class VIII	1 ton	30	18.5	26.0	28.5	34.5	39.0	46.0	60.0
Class IX	2 ton	36	22.0	31.5	34.0	41.5	47.0	55.5	72.0
Class X	3 ton	42	25.5	36.5	40.0	48.5	54.5	64.5	84.0

[1]Lagasse et al. (2006)
[2]Equivalent to spherical diameter

BMP: Storage Bladders

- Storage bladders shall be located and designed to minimize the potential for impacts due to rolling and/or failure. Storage bladders should be stored on flat slopes where stability will not be affected.
- Storage bladders shall be located to minimize the potential for water to flow into a watercourse in the event of a catastrophic failure.
- Bladders shall not be used unless the bladder is safely contained within a secondary containment system with sufficient capacity to capture 110 percent of a bladders maximum volume in the vent of bladder failure.
- Secondary containment is recommended in the form of a dirt berm, containment pit, combination of both, or impermeable material with skeletal support. The containment should be capable of holding 110 percent of the bladders volume.
- Secondary containment systems shall be of sufficient strength and stability to withstand the forces of released contents in the event of catastrophic bladder failure.
- Secondary containment systems that are exposed to precipitation shall be designed and maintained with sufficient capacity to accommodate precipitation and storm water inputs from a 25-year, 24-hour storm event.
- Bladders and containment systems shall be periodically inspected to ensure integrity.

This is an example of a containment pit which will assist in mitigating the impacts if this storage bladder failed.

BMP: Cultivation Site Restoration

- Remove all cultivation and associated materials from designated cultivation site.
  - This includes plant mass, root balls, potting containers, cultivation medium and any materials associated with the preparation, cultivation, and harvest of commercial cannabis.
  - Cultivation medium removed from the site shall be stored/disposed of in compliance with Order conditions related to spoils management.
- All disturbed and/or unstable slopes shall be stabilized and returned to pre-project conditions.
  - Slopes shall be contoured as close as feasible to natural grade and aspect.
  - Temporary erosion control shall be applied to prevent sediment run-off.
- Soil exposed as a result of project work, soil above rock riprap, and interstitial spaces between rocks shall be revegetated with native species by live planting, seed casting, or hydroseeding prior to the rainy season of the year work is completed.
  - Native plants characteristic of the local habitat shall be used for revegetation when implementing and maintaining cleanup/restoration work in riparian and other sensitive areas.
  - Native forbes and gramminoids shall be planted to replace sediment stabilization, sediment filtration and nutrient filtration
  - Native trees and shrubs shall be planted to replace bank stabilization, inputs of large woody debris and temperature control within riparian areas.
  - Restoration of the quality/health of the riparian stand shall promote: 1) shade and microclimate controls; 2) delivery of wood to channels, 3) slope stability and erosion control, 4) ground cover, and 5) removal of excess nutrients.

WDID#: _____

Date: _____

Soil Amendment & Chemical Use

Timberland Resource Consultants
165 South Fortuna Boulevard, Fortuna, CA 95540
707-725-1897 • fax 707-725-0972
trc@timberlandresource.com

Product Type/Name		Annual Amount Applied (Gallons or Pounds)	Nutrient Content/N-P-K Ratio

WDID#: _____

Date: _____

Soil Amendment & Chemical Use

Timberland Resource Consultants
165 South Fortuna Boulevard, Fortuna, CA 95540
707-725-1897 • fax 707-725-0972
trc@timberlandresource.com

WDID#: _____

Date: _____

Monthly Water Tracking

Timberland Resource Consultants
165 South Fortuna Boulevard, Fortuna, CA 95540
707-725-1897 • fax 707-725-0672
trc@timberlandresource.com

Month	Total Surface Water Diversion	Water input to Storage by Source	Water use by Source
January			
February			
March			
April			
May			
June			
July			
August			
September			
October			
November			
December			

WDID#: _____

Date: _____

Monthly Water Tracking

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trc@timberlandresource.com

BMP: Generator, Fuel, and Oil Management (General Requirements and Used Oil and Oil Filters)

All bulk fuel storage or petroleum products, any/all future petroleum products and other liquid chemicals, including but not limited to diesel, biodiesel, gasoline, and oils shall be stored so as to prevent their spillage, discharge, or seepage into receiving waters. Storage tanks and containers shall be of suitable material and construction to be compatible with the substance(s) stored and conditions of storage such as pressure and temperature. Above ground storage tanks and containers shall be provided with a secondary means of containment for the entire capacity of the largest single container and sufficient cover shall be provided to prevent any/all precipitation from entering said secondary containment vessel.

If the volume of a fuel container is greater than 1,320 gallons, a Spill Prevention, Control, and Countermeasures (SPCC) plan will be required for the use the fuel tank.

On-site storage of petroleum products, or other fuels used for commercial activities may require registration as hazardous materials through the California Environmental Reporting System (CERS). Additionally, the waste oil generated from commercial activities (generators) and their used oil filters are considered hazardous waste and requires addition reporting. The discharger is advised to contact local agencies to find out if such reporting is applicable to currently operations

Used motor oil is required to be stored in sealed containers that the oil was originally packaged in, e.g. sealed buckets/quart or gallon jugs, or other sealed containers designed to store motor oil. Stored used oil is required to be regularly disposed of at hazardous waste disposal sites. Used oil filters are also required to be stored in sealed containers, e.g. sealed plastic totes/buckets, for later disposal at a hazardous waste disposal site. These storage containers are required to be stored in structures where they are protected from precipitation.

Further information regarding the State of California's requirements for the managing of Used Oil and Oil Filters can be found by entering the links below or searching the corresponding titles to the links.

California Department of Toxic Substances Control - Used Oil Generator Requirements

- https://www.dtsc.ca.gov/InformationResources/upload/RAG-UsedOilforGenerators.pdf

Department of Toxic Substances Control - Managing Used Oil Filters for Generator

- https://www.dtsc.ca.gov/InformationResources/upload/RAG_Used-Oil-Filters_Generators1.pdf

BMP: Generator, Fuel, and Oil Management (Generators and Pumps)

All generators and petroleum powered pumps are required to have spill trays or secondary containment placed underneath them when using, fueling, or changing oil on them to prevent the potential for leeching, seepage or spillage of petroleum products. All spill trays and containment structures require cover from precipitation. All generators and petroleum powered pump locations are also required to have spill cleanup kits on hand.

Pre-fabricated secondary containment structures and spill trays can be purchased online or from local wholesalers of petroleum products. As an alternative to pre-fabricated secondary containment structures, structures can be constructed from wooden, cinderblock, concrete, or metal frames lined with PVC liners, e.g. pond liner/water bladder material, as long as the containment is fully sealed and constructed in a similar manner to examples of pre-fabricated containment structures found below. Ensure that diked areas are sufficiently impervious to contain discharged chemicals. All containment structures require cover from precipitation to prevent the containment from filling with water. Secondary containment for fuel tanks shall not be constructed.

As an alternative to pre-fabricated spill kits, kits can consist of sealed trashcans or buckets with industrial absorbent material (e.g. cat litter) and shovels, placed nearby any location where generators, pumps, or other petroleum products or chemicals are used.

Examples of industry standard pre-fabricated spill containment and clean-up kits can be found following or entering the links below. Pre-fabricated spill containment and clean-up kits can be purchased online, from Renner Petroleum, or other similar industry providers.

Ultratech Spill Containment

- http://www.spillcontainment.com/categories/spill-containment/

New Pig Portable and Collapsible Spill Containment

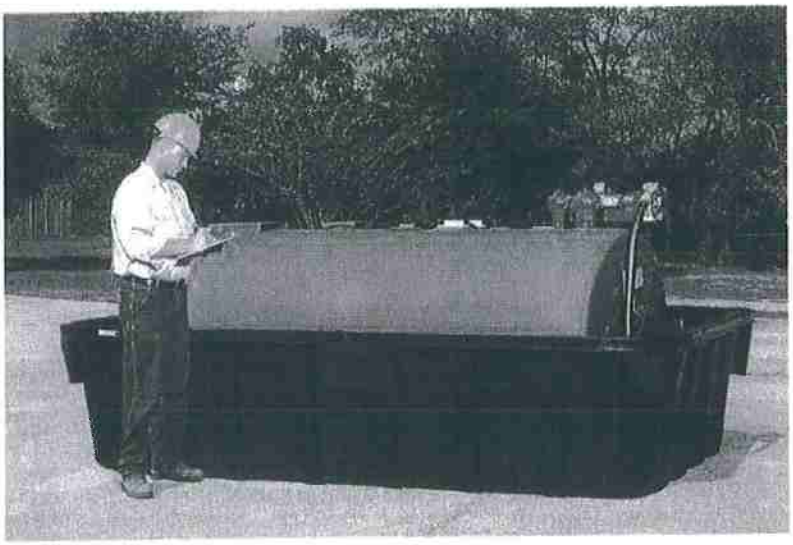
- https://www.newpig.com/collapsible-berms/c/5142?show=All

BMP: Generator, Fuel, and Oil Management

Example of a small, portable, and compact containment berm.

Example of a portable utility spill tray.

BMP: Generator, Fuel, and Oil Management



Example of secondary containment for a fuel tank. This container requires cover from precipitation.

Example of spill pallets for unused or used oil drums and other petroleum products.