



Water Resource Protection Plan

WDID# - 1B171705CHUM

APN 221-121-001-000 & 221-121-013-000

App 11751

Prepared by:

Timberland Resource Consultants

165 South Fortuna Blvd

Fortuna, CA 95540

05-13-2018

Purpose

This Water Resource Protection Plan (WRPP) has been prepared on behalf of the discharger, for the Humboldt County property identified as APN 221-121-001-000 & 221-121-013-000 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. California Regional Water Quality Control Board, North Coast Region, Order R1-2015-0023, conditionally waives the requirement for the property owner to file an 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, 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). 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.

Water Resource Protection Plan

General Location Map [WDID# - 1B171705CHUM]

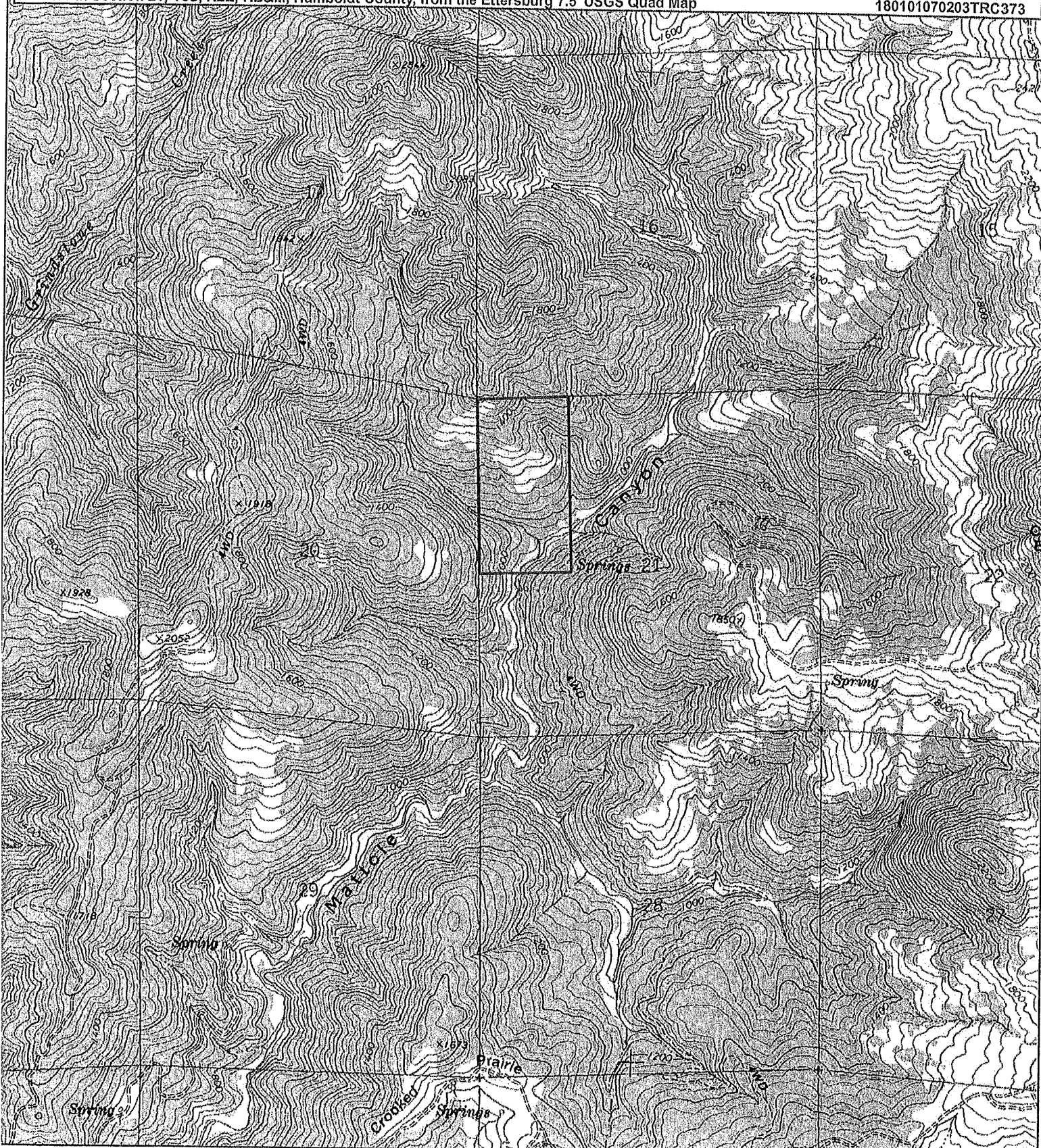


 Property Boundary



Located in Section 21, T3S, R2E, HB&M, Humboldt County, from the Ettersburg 7.5' USGS Quad Map

180101070203TRC373



Property Description

The property assessed consists of two parcels located in primarily conifer timberland. The property is located in Section 21, T3S, R2E, HB&M, Humboldt County, from the Ettersburg 7.5' USGS Quad Map and is approximately 4 miles NNE from Ettersburg. Access to the property is from US Highway 101 to Redwood Drive to Briceland Thorn Road to Ettersburg Road to Dutyville Road.

Project Description

The project currently consists of three living structures, permanent and seasonal roads, five cultivation areas of both greenhouses and outdoor plants, a point of diversion from a spring with multiple hard plastic storage tanks, and a lined, rain-catchment pond.

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 are necessary to 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>). Sites requiring monitoring are indicated as such within the WRPP Mitigation report in the follow pages.

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.

Assessment of the Standard Conditions

Assessment of Standard Conditions consisted of field examinations in the spring 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 in the Mitigation Report to follow.

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

Currently, all roads, driveways, trails, and other defined corridors for foot or vehicle traffic do not have adequate drainage features/structures to prevent or minimize erosion along the flow paths and at their respective outlets. Multiple unstable areas were noted during assessment of the property. Many roads, clearings, fill prisms, and graded areas (cleared/developed areas with the potential for sediment erosion and transport) are not maintained in a manner that they are hydrologically disconnected to surface waters of ephemeral, intermittent, and perennial streams. No stockpiled construction materials are stored in any location that could be transport to receiving waters.

Roads on the property have been historically used for timber harvesting. Roads are being classified as "permanent" (being used year-round), "seasonal" (being used primarily during summer months), and "trail" (being rarely/never used or used occasional to access to features on the property).

During multiple inspection of the roads, cultivation areas, and watercourses, multiple sites were identified where road surface runoff was not being adequately dispersed and erosion of the road surface was occurring. Additionally, multiple sites were identified where existing surface drainage features were not functioning

adequately and erosions was occurring as a result. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

During the assessment of roads, cultivation areas, and other features within the project area, three unstable features were mapped and observed. All three of these feature appear to be on natural ground and not associated with any current or historic development or land use activities. Additionally, three cut/fill slope failures (Sites 10, 12, & 26) were identified and are discussed below.

A large, long-term unstable feature was noted below the road, near Site 19. Observations included extensive corrective growth and non-vertical growth of 20-year plus, conifer trees, uneven and hummocky ground, and a 3-4' vertical scarp running approximately 150' below the base of the road fill. Mitigation will entail the redirection of surface runoff away from the unstable area to avoid further instability. If at any point, this unstable feature should begin to expand in to areas of development, such as the road or adjacent cultivation area, a licensed geologist should be consulted for further mitigation recommendations.

Two unstable features were noted within Cultivation Area E. An area of cracking and slumping natural hillslope in the northwest corner of the cultivation area, approximately 2'L x 20'W with minimal vertical displacement (< 6"), was observed in open grassland on what appears to be natural ground. This unstable feature did not appear to be influenced by surrounding cultivation related activities or any other anthropogenic influences. A past hillslope failure was noted along the southern margin of the cultivation area. Heavy seeps flow from the failed hillslope area and connect to watercourses down slope. Both the area of the failure, and deposited material at the toe of the debris, are well vegetated and appear stable. No direct mitigation is proposed for this either of these unstable features.

At Site 10, road surface runoff and water moving through the fill of a graded area has caused the outboard fill to saturate and fail with delivery to a Class III watercourse below. Removal of failing fill material and stabilization measures are proposed at this location along with corrections to contributing drainage issues. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

At Site 12, a cutbank failure, approximately 25'L x 30'W, failed above and into Cultivation Area C. The failure caused damage to the greenhouse below. While much of the debris had been removed and the cultivation area repaired, some debris material was still present at the time of the assessment and blocking a drainage ditch running along the inboard edge of the cultivation area creating standing water. Remediation of this feature will consist of clearing the ditch to resume free flow of runoff and seeps as well as rock armoring the failed portion of cutbank to reduce the potential for future instability. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

At Site 26, a road fill failure has occurred on a legacy road that is no longer used. The lower extent of the failed material was delivered to a Class I watercourse below the road. Failed material has since removed and transported downstream by stream flows. Some fill material remains perched above the watercourse with the potential to deliver sediment. However, much this sediment is not within reach of an excavator due the steep channel side slopes and the lack of sufficient road width without extensive additional impacts by heavy equipment. Remediation of this feature will consist of laying back the accessible remaining side slopes and removing any perched fill that is within reach of an excavator, as well as planting of appropriate riparian

trees within the failed area. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

Summary of Standard Conditions Compliance (Cont.)

Cultivation Area	Area (sq. ft.)	Cultivation Area Slope (%)	Surrounding Hill Slope (%)	Distance to Nearest Class I Watercourse (ft)	Distance to Nearest Class II Watercourse (ft)	Distance to Nearest Class III Watercourse (ft)
A	22,772	5	26	>200	>200	>200
B	30,594	5	21	>200	>200	>200
C	36,767	5	26	>200	>200	85
D	23,167	5	27	>200	>140	70
E	22,111	28	28	>200	0	70
F	12,742	28	28	>200	>200	180

Cultivation Area A consists of three hoop-houses on the margins of clearing, on a graded flat. Surrounding the cultivation area are densely vegetated forest of conifer and hardwood with the nearest watercourse approximately 220' away. The cultivation area is well drained with no associated erosion.

Cultivation Area B consists of two greenhouses with raised bed, in an open area, on a graded flat. Individual plants in above ground pots are placed around the graded area on the natural slopes. Surrounding the cultivation area is densely grassland with the nearest watercourse approximately 240' away. The cultivation area is well drained with no associated erosion.

Cultivation Area C consists of three greenhouses in an open area, on a graded flat. Surrounding the cultivation area is densely grassland with the nearest Class III watercourse approximately 85' away. The cultivation area is well drained with no associated erosion.

Cultivation Area D consists of two greenhouses with raised beds, in a clearing, on a graded flat. Surrounding the cultivation area are densely vegetated forest of conifer and hardwood with the nearest Class III watercourse approximately 70' away and the nearest Class II watercourse approximately 140' away. The cultivation area is well drained with no associated erosion.

Cultivation Area E consists of individual plants, in above ground pots, placed on the natural hillslopes. Surrounding the cultivation area is densely grassland as well as densely vegetated forest of conifer and hardwood. A Class II watercourse begins within the southern portion of the cultivation area (see attached maps) and flows east out of the cultivation area to a confluence with a Class III watercourse approximately 165' downslope. The cultivation area is well drained with no associated erosion. Unstable areas previously discussed are not causing any current erosion.

Cultivation Area F consists of individual plants, in above ground pots, placed on the natural hillslopes. Surrounding the cultivation area are densely vegetated forest of conifer and hardwood with the nearest watercourse approximately 180' away. The cultivation area is well drained with no associated erosion.

Summary of Standard Conditions Compliance (Cont.)

2. Stream Crossing Maintenance

There are five stream crossings located on the property. Three of these five crossings are appropriately sized for a 100-year storm event, but are in need of maintenance to be fully functional. The other two crossings are on legacy roads that are no longer in use and lack any type of crossing structure. The road and crossing at Site 23 are located on low gradient natural slopes. Thus, the crossing and road involve little to no fill material to be eroded by the lack of a crossing structure. No mitigation is proposed at this site. The crossing at Site 25 also lacks any type of crossing structure. The road at this location consists of full bench construction. No erosion was observed at this location. Because this crossings has the potential for future diversion should significant sediment deposition occurs, mitigation of this site will consist of hand tool work to create a greater defined flow path through/across the road surface. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

These minor modifications to existing crossings do not represent any significant modification to the natural stream channel and subsequently will not a Lake and Streambed Alteration Agreement with the California Department of Fish and Wildlife.

ID NUMBER	Rational Method			W&C		Number Records=	
	(ac)	(ft)	(mi)	(1000's ft)	(in)	(in)	
D_AREA	K_VALUE	ELEV_D	LENGTH	ALTITUDE	CMP DIA	HW	
Site 06	1	0.40	0	0.0	0.0	18	0
Site 07	1	0.40	0	0.0	0.0	18	0
Site 20	1	0.40	0	0.0	0.0	18	0

Precipitation Depth-Duration-Frequency Values					Mean Annual Rainfall (in) =	
					Number of Records =	59
					Number of Records =	40
50-Year Storm			100-Year Storm			
Time, Min	Depth (in)	Inch/hr.	Time, Min.	Depth (in)	Inch/hr.	
10	0.400	2.40	10	0.632	3.79	

ID#	Existing	Headwall	Selected	Discharge	Q100	Culvert	Culvert is	Recommended	
	Culvert (D)	(HW)						Culvert Dia.	Recommendation
	Diameter (in)	Height (in)	Method	(cfs)	(cfs)	Capacity	Undersized	(in)	Based On
Site 06	18	0	RATIONAL	2	6			18	Q100
Site 07	18	0	RATIONAL	2	6			18	Q100
Site 20	18	0	RATIONAL	2	6			18	Q100

3. Riparian and Wetland Protection and Management

Multiple assessments of the property concluded that Cultivation Areas A, B, C, D, & F and associated facilities are not located or occurring within 100' of any Class I or II watercourse or within 50' 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.

Summary of Standard Conditions Compliance (Cont.)

A Class II watercourse originates from the past hillslope failure located in the southern portion of Cultivation Area E connecting to watercourses below the cultivation area. Due to the majority of the cultivation area being located within the riparian setback of the Class II watercourse and the remaining portion outside of the setback containing an additional unstable feature, this cultivation area is to be decommission and future use discontinued. All cultivation related activity and associated material are to be removed from and relocated to an appropriate location where they cannot be transported to a watercourse by wind or rain. Historic aerial imagery does not show any observable modifications of the natural hillslope of vegetation in the last 20 years. Because this cultivation style consists of individual plants in above ground pots, on un-modified natural hillslopes, the small areas where pots are removed shall be allowed to revegetate naturally by adjacent grasses.

At Site 17, an above ground, non-rigid pot containing potting soil has spilled onto the margin of the adjacent Class II watercourse. This soil shall be removed immediately, as completely as is feasible without disturbance to the channel or existing vegetation. Removed soil shall be disposed of appropriately at a landfill transfer station or stored in a location where it cannot be transported to a watercourse by wind or rain.

At Site 26, a road fill failure has occurred on a legacy road that is no longer used. The lower extent of the failed material was delivered to a Class I watercourse below the road. Some fill material remains perched above the watercourse with the potential to deliver sediment. However, much of this sediment is not within reach of an excavator due the steep channel side slopes and the lack of sufficient road width without extensive additional impacts by heavy equipment. Remediation of this feature will consist of laying back the accessible remaining side slopes and removing any perched fill that is within reach of an excavator, as well as planting of appropriate riparian trees within the unstable feature. Further details of site specific descriptions and proposed mitigation measures can be found in the Mitigation Report to follow.

Two 50,000-gallon bladders are currently located within the riparian setback in the southern portion of the property. Because these bladders are not currently in use nor planned for any future use, they are to be removed from the riparian area.

4. Spoils Management

Currently, no spoils are not stored or placed in or where they can enter any surface water. Any/all spoils are adequately contained or stabilized to prevent sediment delivery to surface waters. Any/all spoils generated through development or maintenance of roads, driveways, earthen fill pads, or other cleared or filled areas have not been sidecast in any location where they can enter or be transported to surface waters. Any/all future spoils generated as a result of any future construction projects that are to be stored on the property shall be done so in accordance with the BMP's.

5. Water Storage and Use

All water on the property is derived from the diversion of surface water from a spring located on the property. The diversion structure consists of an approximately 36" cistern collecting water from an unknown depth. This spring meets and exceed the required water demands for both agricultural and domestic use and does not connect to a watercourse.

Summary of Standard Conditions Compliance (Cont.)

At this time the discharge has 215,050 gallons of water storage in the form of hard plastic tanks installed. Additionally, the discharger has a 280,000-gallon rain-catchment pond. This pond is exclusively rain catchment as it is lined and the margins of the pond have been constructed to drain away from the pond. A total of 495,050 gallons of stored water meets and exceeds the demands of water from both agricultural and domestic use while complying with Forbearance Period. While a water metering device was noted during out assessment, it did not appear to meter all water being used on the property. Additional water metering device(s) shall be installed immediately to record water usage data. This water metering system shall record both water used for cannabis and domestic uses separately.

A Lake and Streambed Alteration Agreement with the California Department of Fish and Wildlife, as well as an Initial Statement of Water Diversion and Use with the California State Water Resource Control Board Division of Water Rights, shall be required to continue use of these diversions. Any additional guidelines, treatments, or restrictions set forth under the finalized Lake and Stream Agreement 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 five cultivation sites.

7. Fertilizers and Soil Amendments

Fertilizers, potting soils, compost, and other soils and soil amendments are to be stored in structures on the property in a manner in which they will not enter or be transported into surface waters and so that nutrients or other pollutants will not be leached into groundwater. Such items were observed being stored uncontained and in uncovered locations in Cultivation Areas A & D. Fertilizers and soil amendments are applied and used per the manufacturers guidelines. Cultivation areas are currently maintained so as to prevent nutrients from leaving the site during the growing season and post-harvest.

8. Pesticides and Herbicides

The use of pesticide products is consistent with product labeling and all products on the property are currently stored in closed structures to ensure that they do not enter or are released into surface or ground waters.

9. Petroleum Products and Other Chemicals

Currently, fuel storage and petroleum products are present on the property in compliance with the Order. A 500-gallon diesel fuel tank is stored under adequate cover with secondary containment and additional non-fuel, lubrication products are stored within an enclosed structure. Should the discharger at any point in the future obtain additional 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

Summary of Standard Conditions Compliance (Cont.)

available onsite if the volume of a fuel container is greater than 1,300 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.

10. Cultivation-Related Wastes

Cultivation related waste was observed at Site 14 in the form discarded stems that have been dumped over the bank of the cultivation area. These stems shall be gathered and either mulched or burned in an appropriate location (greater than 50' from a Class III watercourse or 100' from a Class I/II watercourse).

11. Refuse and Human Waste

Garbage and refuse is removed from the property as it is produced and hauled away to a landfill transfer station. However, old refuse disposal sites were observed at Sites 04 & 21. The refuse at these sites is to be gathered and disposed of appropriately at a landfill transfer station.

Human waste is managed by a multiple outhouse with pit toilets. Use of these outhouses is to either be discontinued and an appropriate human waste disposal system installed or have these facilities inspected and approved by a qualified professional. It is the discharger's responsibility to ensure compliance of such action with the Humboldt County Department of Environmental Health and Human Services.

12. Remediation/Clean-up/Restoration

Currently, seven of the Standard Conditions is not being met; Site Maintenance, Erosion Control, and Drainage Features, Stream Crossing Maintenance, Riparian And Wetland Protection and Management, Water Storage and Use, Fertilizers and Soil Amendments, Cultivation-Related Wastes, and Refuse and Human Waste. 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

- ☐ In-organic cultivation related wastes should be removed and disposed of properly at a landfill transfer station or stored in an appropriate location greater than 200' from a watercourse where it cannot be transported by wind or rain, see Appendix B, BMP 137 of the Order. Organic cultivation related waste can either be composted or burned in the winter.
- ☐ Water use shall be designed and metered such that water used for the irrigation of cannabis will be recorded. Water use for the irrigation of cannabis is to be recorded monthly for annual reporting.
- ☐ Fertilizer, soil amendments, and pesticide use is to be recorded in such a manner that cumulative annual totals are recorded for annual reporting.
- ☐ 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.
- ☐ A Lake and Streambed Alteration Agreement with the California Department of Fish and Wildlife, as well as an Initial Statement of Water Diversion and Use with the California State Water

Summary of Standard Conditions Compliance (Cont.)

- ☐ Resource Control Board Division of Water Rights shall be required to continue use of any surface water diversions and prior to any in-stream work. Any additional guidelines, treatments, or restrictions set forth under the finalized Lake and Stream Agreement shall be followed.
- ☐ Existing or newly installed road surface drainage structures such as water bars, rolling dips, ditch relief culvers, and intentionally in/out-sloped segments of road shall be maintained to ensure continued function of capturing and draining surface runoff.
- ☐ Road surfaces should be maintained via grading, as needed, to prevent road surface runoff from being trapped in and eroding wheel tracks.

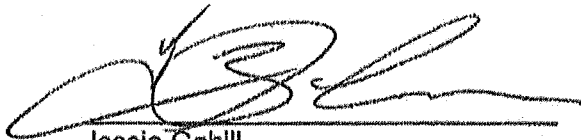
Interim Measures

- ☐ If at any point, the unstable feature below Site 19 should begin to expand in to areas of development, such as the road or adjacent cultivation area, a licensed geologist should be consulted for further mitigation recommendations.
- ☐ If mitigations proposed at Site 06 are not performed prior to 10/15/2018, the culvert outlet shall be shortened and small rock hand placed below the outlet to reduce the potential for erosion of the channel below the outlet.
- ☐ If mitigations proposed to at Sites 09 & 24 to repair existing surface drainage features with required heavy equipment are not performed prior to 10/15/2018, hand tool work shall be done to regain as much function of these features as is feasible prior to winter.
- ☐ If mitigations proposed to the fill failure at Site 11 are not performed prior to 10/15/2018, a straw bale wall shall be installed below the toe of the failed material to capture sediment and reduce sediment delivery to the watercourse below. These bales shall form a continuous wall without gaps that is wider than the failed material and shall be staked down. The wall shall follow hillslope, on contour (a line flowing one consistent elevation) as much as is feasible.

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

Prepared by Timberland Resource Consultants

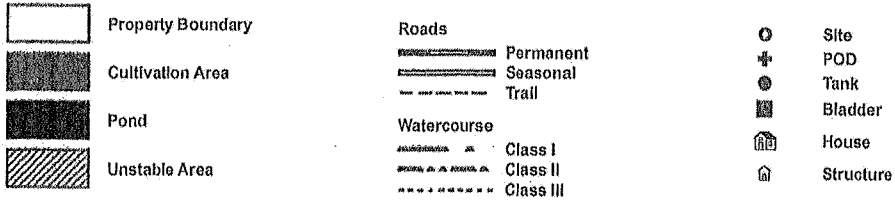
1. This Water Resource Protection Plan has been prepared for the property within APN 208-331-009-000 & 221-121-013-000, in Humboldt County, at the request of the Client.
2. Timberland Resource Consultants does not assume any liability for the use or misuse of the information in this Water Resource Protection 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.



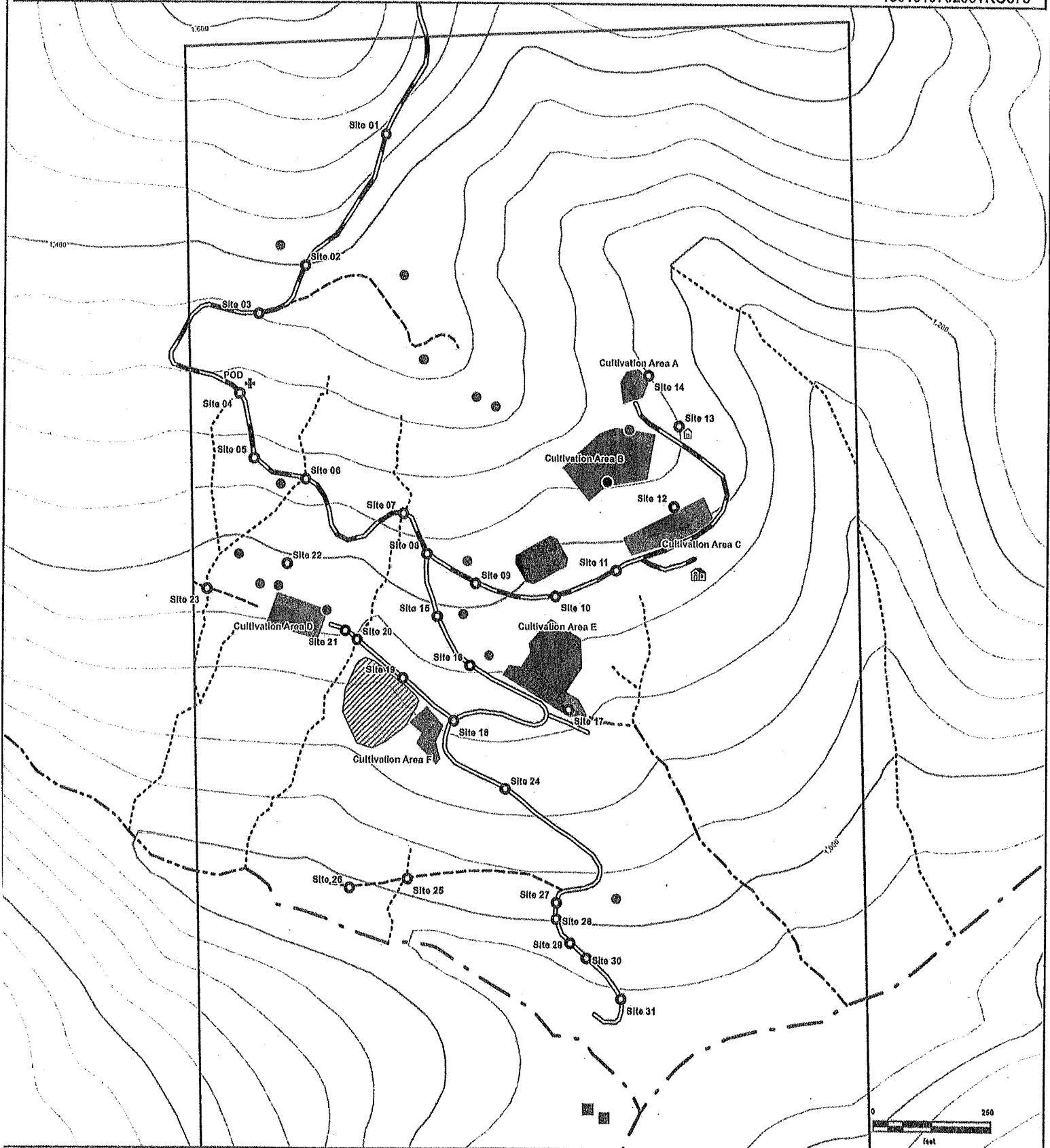
Jessie Cahill
Timberland Resource Consultants

Water Resource Protection Plan

Site Map [WDID# - 1B171705CHUM]

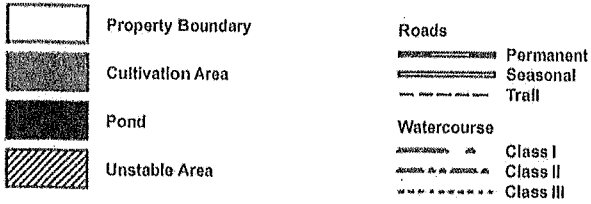


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Water Resource Protection Plan

Site Map [WDID# - 1B171705CHUM]



180101070203TRC373





WRPP - Mitigation Report

WDID# - 1B171705CHUM

Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 01	-123.967248 40.193776	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: Existing 15" DRC is functioning adequately but does not capture road surface runoff.						Prescribed Action: The road shall be reshaped near the Inlet of the DRC to facilitate road surface drainage.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 02	-123.967845 40.193015	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 03	-123.968194 40.192734	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: A long inboard ditch lacks adequate relief structures.						Prescribed Action: 18" DRC shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 04	-123.968326 40.192272	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new rocked rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 05	-123.968209 40.191898	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's.		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 06	-123.967814 40.191782	Permanent	X	X	-	A.2.	Prior to 10/15/19	
Current Condition: Existing Class II watercourse crossing with an 18" culvert. The culvert is appropriately sized for a 100-year storm event, however, the outlet of the culvert is too long and creates a shotgun outlet. Refuse has also been dumped over the road and is present in the channel below.						Prescribed Action: The shotgun outlet of the culvert is to be cut back and energy dissipator installed below the new outlet. Additionally, all refuse below the outlet shall be gathered and disposed of appropriately at a landfill transfer station.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 07	-123.967061 40.19159	Permanent	X	X	-	A.2.	Prior to 10/15/18	
Current Condition: Existing Class III watercourse crossing with an 18" culvert. The crossing receives some additional water from seeps drained by approximately 40' of rock, inboard ditch. The culvert is appropriately sized for a 100-year storm event. Both the inboard and outboard fill faces of the crossing are rock armored and energy dissipator has been installed at the outlet. Some of the energy dissipator is currently obstructing the outlet of the culvert.						Prescribed Action: Energy dissipator and any other obstructing material shall be removed from the outlet area.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 08	-123.966881 40.19136	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: An existing 18" DRC currently drains the inboard ditch of the permanent road into the beginning of the inside ditch associated with the intersecting seasonal road. The culvert is exposed in the road surface and damage from vehicular traffic.						Prescribed Action: The existing DRC shall be removed and a new 18" DRC shall be installed to drain water directly down slope instead of into the adjacent ditch.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 09	-123.966508 40.191193	Permanent	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: Existing rolling dip (type-1) feature is not functioning adequately as the outlet has filled in with sediment.						Prescribed Action: The existing feature shall be repaired/maintained to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 10	-123.965896 40.191127	-	-	-	-	A.1.	-	
Current Condition: Existing rolling dip (type-1) feature is functioning adequately.						Prescribed Action: None		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 11	-123.965439 40.191281	Permanent	X	X	-	A.1.	Prior to 10/15/19	
<p>Current Condition: At this location, an 18" DRC with a vertical drop-inlet was installed to capture flows from surface runoff, the pond overflow, as well as seeps from the cutbank associated with this graded flat. The outlet of this culvert flows into a channel that connects to a watercourse below. However, it appears that while some of the captured water is being transmitted through the culvert, some flows may not be captured by the inlet and moving through the fill prism. An obvious difference of flow was noted entering the culvert inlet area compared to that at the outlet to the culvert. It is unclear as to whether water is bypassing the culvert inlet, or the culvert is separated at a coupler within the fill. Saturation of the outboard fill is evident and a fillslope failure is occurring above and adjacent of the culvert outlet, along the western outboard fill (see mapped adjacent Unstable Area).</p>						<p>Prescribed Action: Initially, the drop inlet structure shall be removed and catchment basin shall be constructed to deliver flows into the inlet of the culvert. Care shall be taken not to damage the inlet and to heavily compact fill material around the inlet. Function of the culvert shall be monitored during following months when flows are present. Should a difference in flows at the inlet and outlet remain after modification of the inlet, the existing culvert shall be completely removed and replaced. In addition to repair of the culvert, because the graded area is wider than necessary at the location of the outboard fill failure, the fillslope at this location shall be laid back to a stable angle of 2:1. The new laid back fillslope shall be compacted by heavy equipment following excavation. The laid back fillslope shall be seeded, straw mulched, and have straw or fiber wattles installed and staked down at 6' intervals. See attached BMP's Unstable Fill Removal and Treatment.</p>		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 12	-123.965012 40.191656	-	X	X	-	A.1.	Prior to 10/15/19	
<p>Current Condition: Location of a cutbank failure associated with the construction of a graded flat, approximately 25' L x 30' W. The cutbank failed above and into Cultivation Area C and caused damage to the greenhouses below. Much of the debris has been removed and the cultivation area repaired. Some debris material was still present at the time of the assessment and blocking a drainage ditch running along the inboard edge of the graded flat and draining to the DRC at Site 11. The obstructing debris is creating standing water.</p>						<p>Prescribed Action: The ditch shall be cleared of obstructing debris to resume free flow of runoff and seeps immediately. Any remaining unstable debris from the cutbank is to be excavated and stored at an appropriate location where it cannot be delivered to a watercourse by wind or rain. The remaining cutbank shall be rock armored 3/4 of the way up with large, angular rip-rap (see attached BMP). Remaining exposed cutbank shall be seeded with a native seed mix.</p>		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 13	-123.964985 40.192122	-	-	X	-	A.10.	-	
<p>Current Condition: Spatial reference to cultivation related storage stored appropriately.</p>						<p>Prescribed Action: None</p>		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 14	-123.96522 40.192412	-	X	X	-	A.10.	Immediately	
<p>Current Condition: Spatial reference to improperly disposed of cultivation related wastes.</p>						<p>Prescribed Action: Stem matter is to be gathered and disposed of appropriately by either burning or composting.</p>		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 15	-123.966797 40.190999	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 16	-123.966539 40.190719	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 17	-123.965782 40.190475	-	X	X	-	A.3, A.7, A.10	Immediately	
Current Condition: At this location, an above ground, non-rigid pot containing potting soil has spilled onto the margin of the adjacent Class II watercourse.						Prescribed Action: This soil shall be removed as completely as is feasible without disturbance to the channel or existing vegetation. Removed soil shall be disposed of appropriately at a landfill transfer station or stored in a location where it cannot be transported to a watercourse by wind or rain.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 18	-123.966656 40.190399	-	-	-	-	A.1.	-	
Current Condition: Existing 18" DRC is functioning adequately.						Prescribed Action: None		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 19	-123.967043 40.190641	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: Segment of road above an unstable feature.						Prescribed Action: A new inboard ditch shall be installed from Site 20 to Site 18 to drain all runoff away from the unstable feature below the road.		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 20	-123.967394 40.190858	Seasonal	X	X	-	A.2.	Prior to 10/15/20	
Current Condition: Existing Class III watercourse crossing with and 18" culvert is functioning adequately and is appropriately sized for a 100-year storm event. The crossing fill lacks a critical dip feature.						Prescribed Action: A critical dip feature shall be added to the crossing to the standards set forth in the attached BMP's to prevent future diversion potential.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 22	-123.967942 40.191292	-	X	X	-	A.11.	Immediately	
Current Condition: Location of improperly disposed of refuse.						Prescribed Action: All refuse is to be gathered and disposed of at a landfill transfer station.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 21	-123.967488 40.190909	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: Cultivation area and road surface runoff are potentially hydrologically connected to the adjacent watercourse crossing.						Prescribed Action: A new rolling dip (type-1) shall be installed at this location to the standards set forth in the attached BMP's to hydrologically disconnect the watercourse crossing.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 23	-123.968548 40.19114	Trail	-	X	-	A.1.	-	
Current Condition: A Class II watercourse crosses and old unused road. The crossing consist of little to no road fill and does not appear to have any further potential for erosion. The channel through the road is well defined with no potential for diversion.						Prescribed Action: None		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 24	-123.966255 40.190012	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: At this location, seeps flowing into an existing inboard ditch are escaping on the road surface due to sediment and debris obstructing ditch flow and causing erosion of the surface.						Prescribed Action: The inboard ditch shall be maintained and cleared of any obstructing sediment or debris that prevent flows from being confined to the ditch.		



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Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 25	-123.966978 40.189486	Seasonal	X	X	-	A.2.	Prior to 10/15/18	
Current Condition: A Class III watercourse flows across an unused, legacy road without any observed erosion, however some potential for diversion exists.						Prescribed Action: Hand tool work shall be done to create a defined flow path across the road surface. Small, native road shall be used to line the bottom of the channel constructed through the road. No modifications shall be made to the existing channel above or below the road.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 26	-123.967419 40.18943	Trail	X	X	-	A.1, A.3	Prior to 10/15/19	
Current Condition: A road fill failure has occurred on a legacy road that is no longer used. The lower extent of the failed material was delivered to a Class I watercourse below the road. Some fill material remains perched above the watercourse with the potential to deliver sediment. However, much of this sediment is not within reach of an excavator due the steep channel side slopes and the lack of sufficient road width without extensive additional impacts by heavy equipment.						Prescribed Action: The remaining perched fill material that is accessible by an excavator, without reconstruction of the road prism, laid back to a more stable angle. Care shall be taken by the operator to not disturb the underlying natural hillslope. Spoils material shall be placed where it cannot be transported to a watercourse by wind or rain. The remaining unstable feature shall be planted with appropriate riparian trees (alder) to reduce the potential for further erosion.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 27	-123.965847 40.189363	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new waterbar feature shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 28	-123.965843 40.189269	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new waterbar feature shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 29	-123.965738 40.189133	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new waterbar feature shall be installed at this location to the standards set forth in the attached BMP's.		



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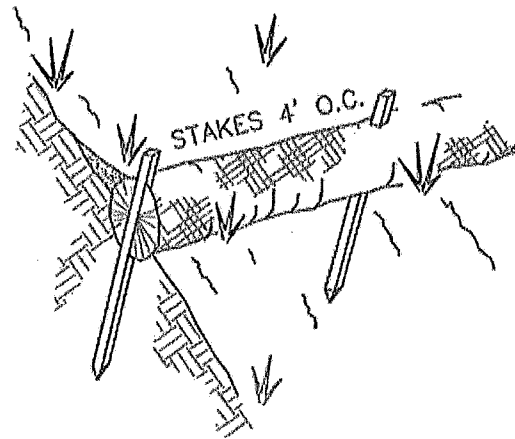
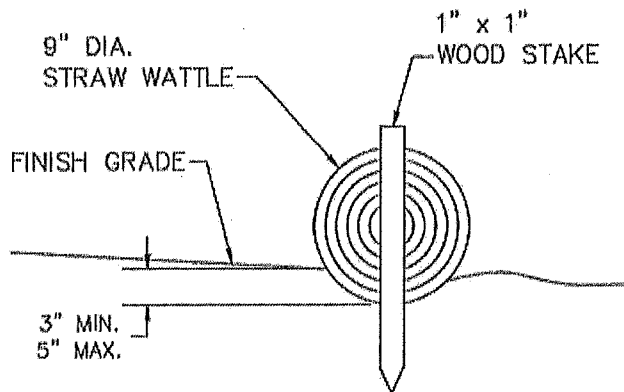
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 30	-123.965612 40.189047	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new waterbar feature shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
Site 31	-123.965344 40.188816	Seasonal	X	X	-	A.1.	Prior to 10/15/19	
Current Condition: The road lacks adequate surface drainage features to prevent the concentration of surface runoff and erosion of the road surface.						Prescribed Action: A new waterbar feature shall be installed at this location to the standards set forth in the attached BMP's.		
Unique Point	Lat-Long NAD 83	Road Type	Mitigation Planned	Monitor	1600	Standard Conditions	Treatment Priority	Date Completed
POD	-123.968251 40.192328	-	-	X	-	A.5.	-	
Current Condition: Spatial reference to a Point Of Diversion (POD) consisting of a 36" cistern in a Class II spring.						Prescribed Action: None		

BMP: General BMP's

- 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: Erosion Control

- 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: Permanent Culvert Crossing

- New culvert installations shall be sized to accommodate a 100-year storm.
- 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, at a minimum of one-third to one-half the culvert diameter.
- Critical dips shall be installed on culvert crossings to eliminate diversion potential. Refer to Figure 86 below.
- Road approaches to crossings shall be treated out to the first drainage structure (i.e. waterbar) 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 feasibly 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.

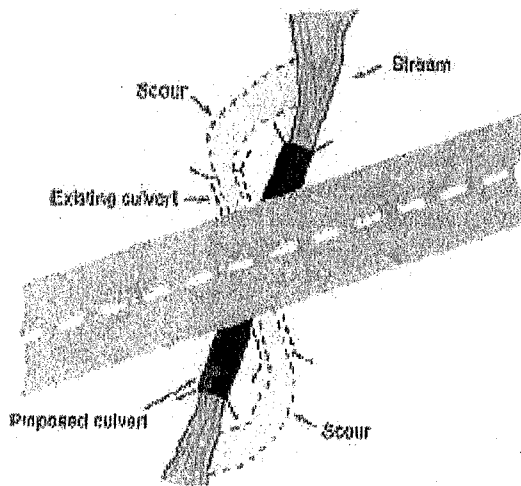


FIGURE 97. Culvert alignment should be in relation to the stream and not the road. It is important that the stream enters and leaves the culvert in a relatively straight horizontal alignment so streamflow does not have to turn to enter the inlet or discharge into a bank as it exits. This figure shows 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).

BMP: Permanent Culvert Crossing (Cont.)

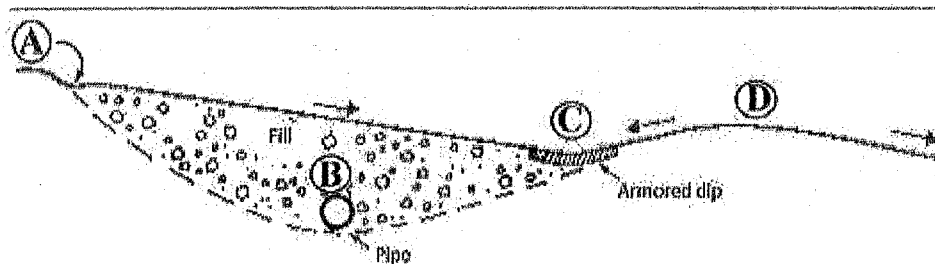
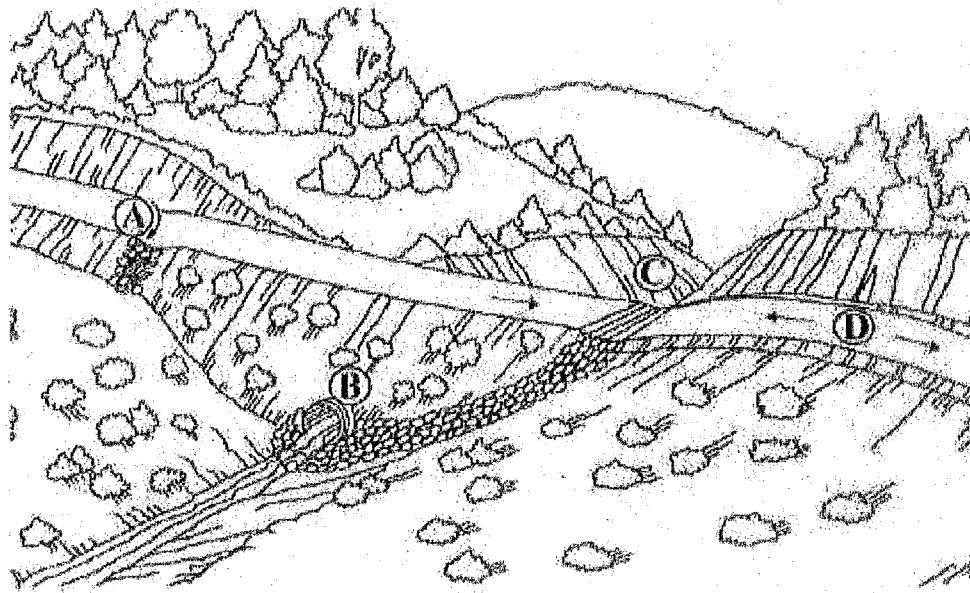


FIGURE 84. Critical dips or dipped crossing fills should be centered near a stream crossing's down-road hinge line, not over the centerline of the crossing where overtopping could cause washout or severe erosion of the fill. If the stream crossing culvert (B) plugs, water will pond behind the fill until 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).

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BMP: Permanent Culvert Crossing (Cont.)

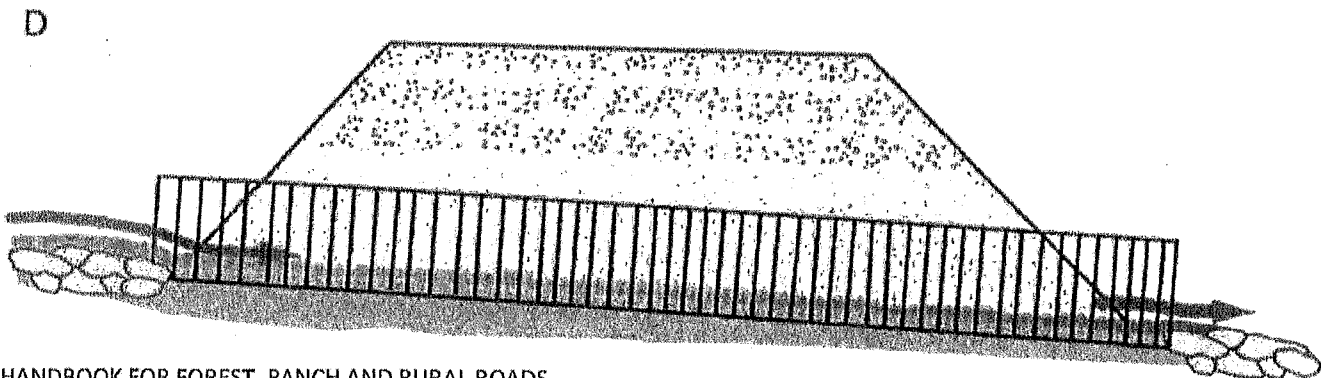
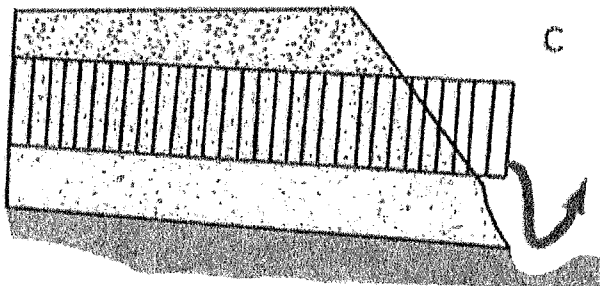
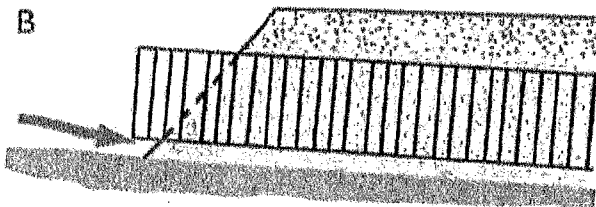
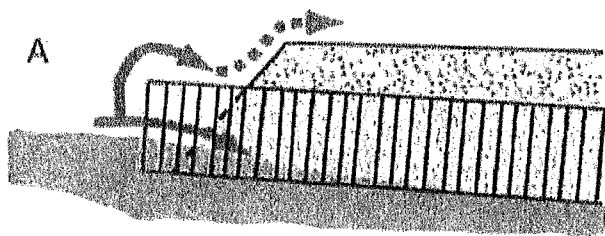
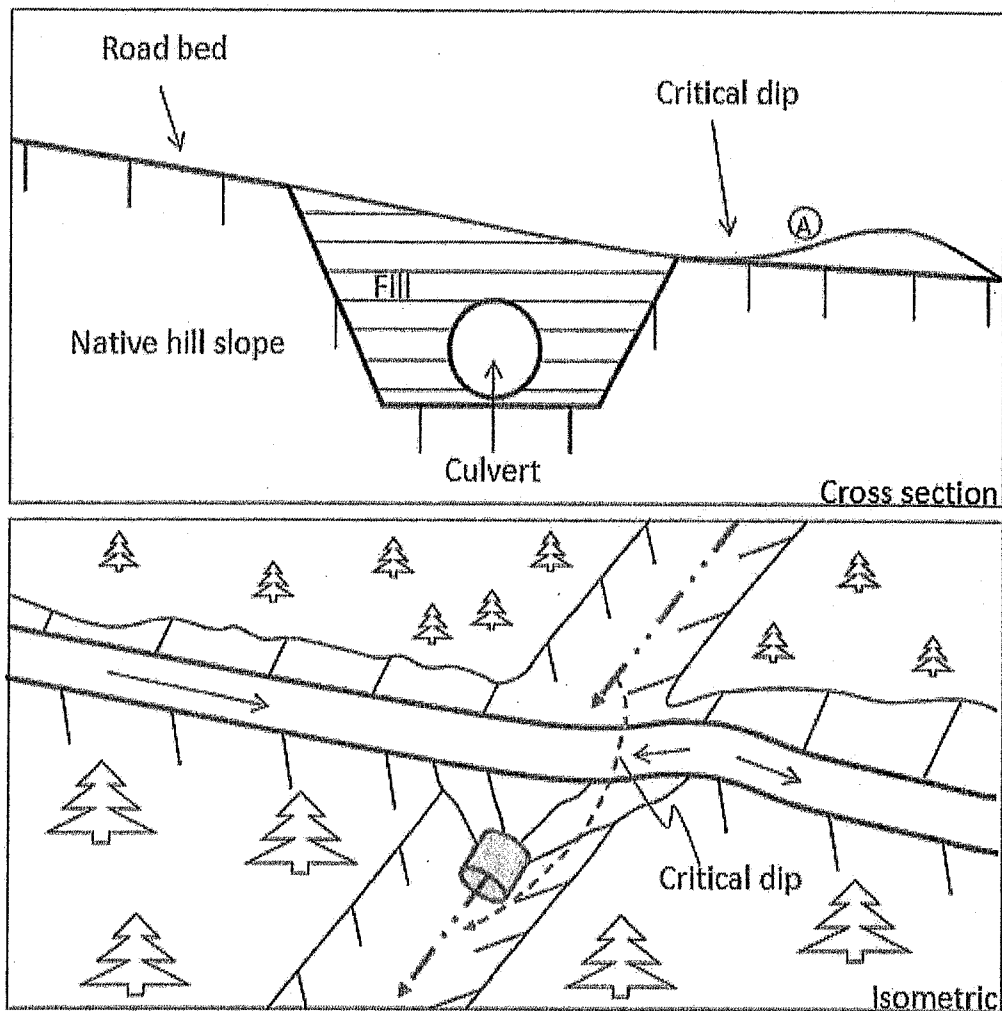


FIGURE 155. Proper culvert installation involves correct culvert orientation, setting the pipe slightly below the bed of the original stream, and backfilling and compacting the fill as it is placed over the culvert. Installing the inlet too low in the stream (A) can lead to culvert plugging, yet if set 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).

BMP: 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: Inlet and Outlet Armoring

- 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 filled with smaller gravels and rocks.

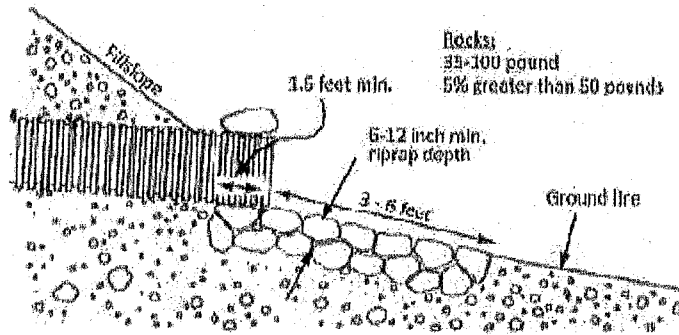


FIGURE 107A. Riprap armor at culvert outlet (Modified from: Keller et al., 2011).

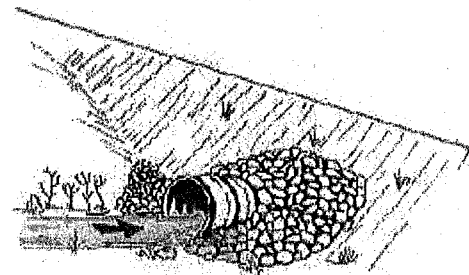


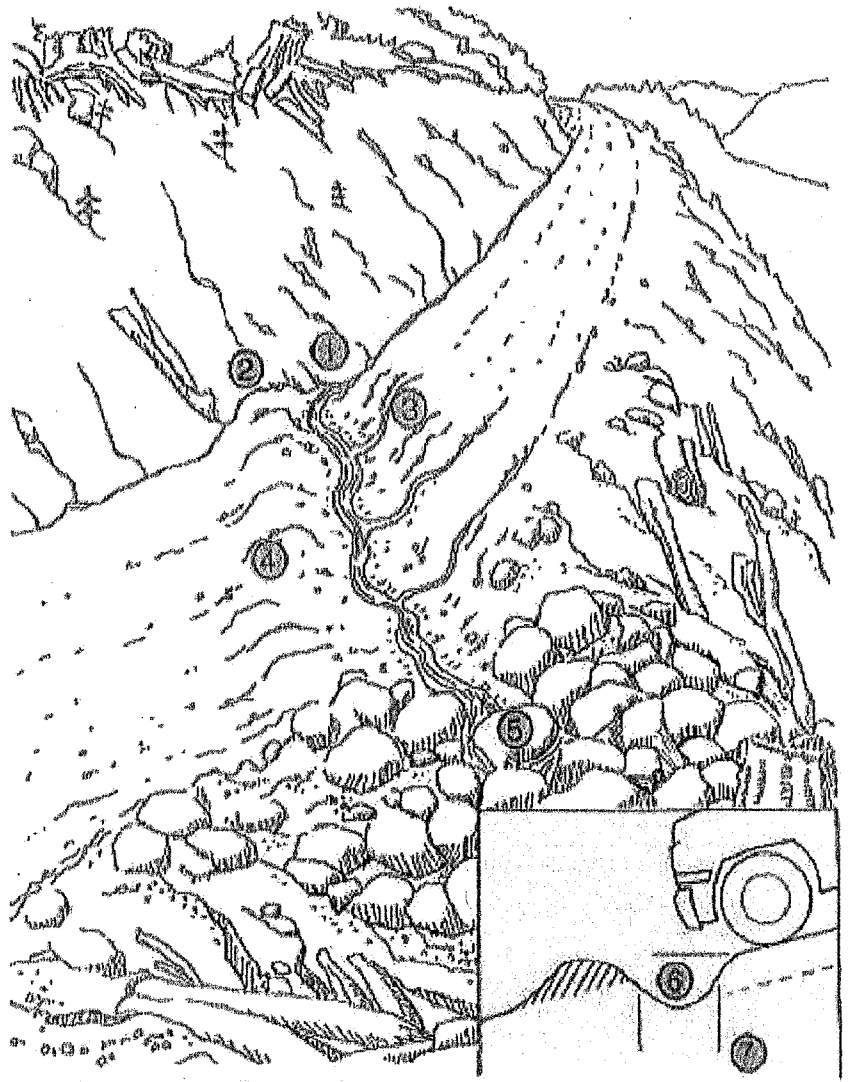
FIGURE 107B. Riprap armor at culvert inlet (Keller and Elmer, 2003).

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

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 bermed 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: 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.
- Downspouts longer than 20 feet should be secured to the hillslope for stability.
- Ditch relief culverts should not carry excessive flow such that gulying occurs below the culvert outlet.
- Do not discharge flows from ditch relief culverts onto unstable or highly erodible hillslopes.
- If the ditch is on an insloped or crowned road, consider using outsloping to drain the road surface. The ditch and the ditch relief culvert would then convey only spring flow from the cutbank and upslope ditch, and not turbid runoff from the road surface.

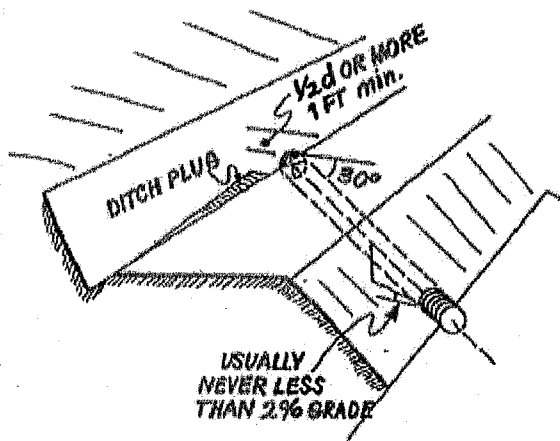
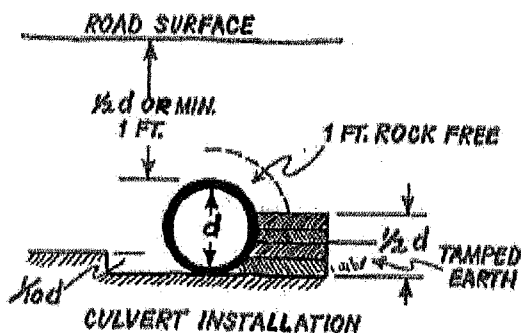


FIGURE 48. The elements of a properly installed ditch relief culvert. The culvert is angled at about 30 degrees to the road alignment to help capture flow and prevent culvert plugging or erosion of the inlet area. It is set at the base of the fill (ideally) or with a grade slightly steeper than the grade 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: Ditch Relief Culvert (Cont.)



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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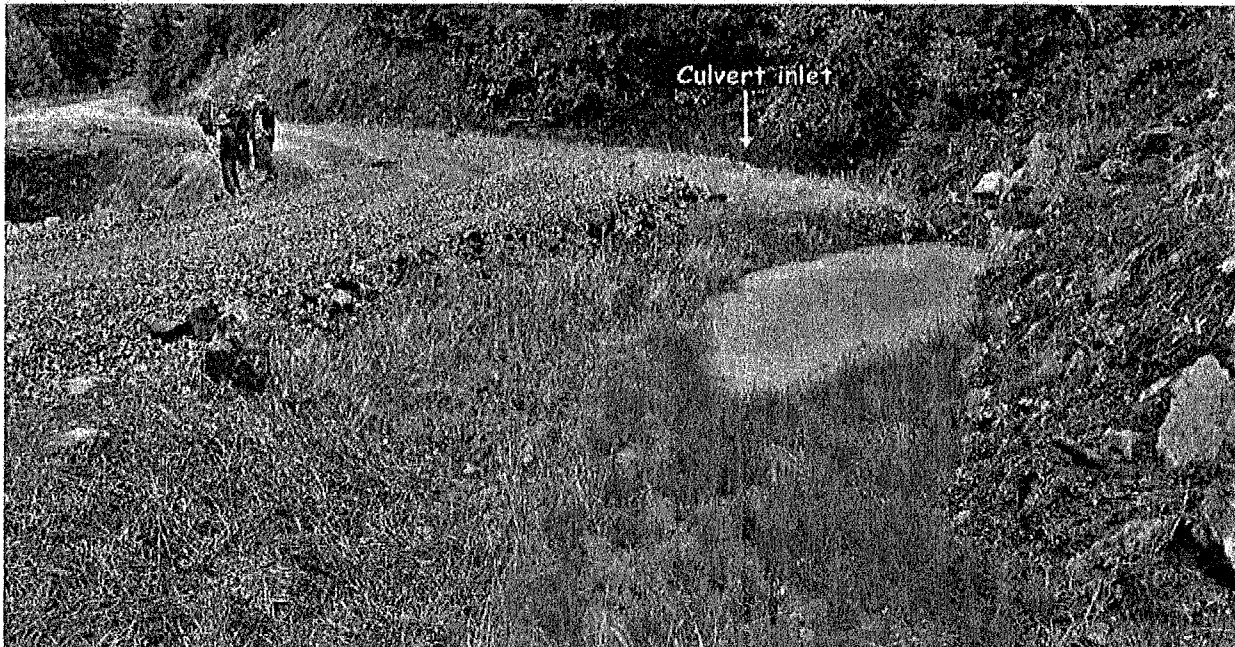


FIGURE 238. Traffic and surface runoff from graveled roads often produces surface erosion, turbid runoff and fine sediment transport that can be delivered to streams. Where ditches can't be eliminated, sediment traps and roadside settling basins can be installed to capture and remove most of the eroded 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: Rolling Dip

- Rolling dips are drainage structures designed to carry surface water across roads.
- The truck road shall dip into and out of the rolling dip to minimize diversion potential.
- The rolling dip shall be constructed with clean native materials.
- The rolling dips outlet may be armored to resist down-cutting and erosion.
- Do not discharge rolling dips into swales 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.

BMP: Rocked Rolling Dip

- Rocked rolling dips are drainage structures designed to carry surface water across roads.
- The truck road shall dip into and out of the rocked rolling dip to minimize diversion potential.
- The rocked rolling dip shall be constructed with clean native rock that is large enough to remain in place during peak flows. Rock size shall vary relative to the size of the watercourse; however an average 6" sized rock shall be used.
- 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 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 swales 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 must be drivable and not significantly inhibit traffic and road use.

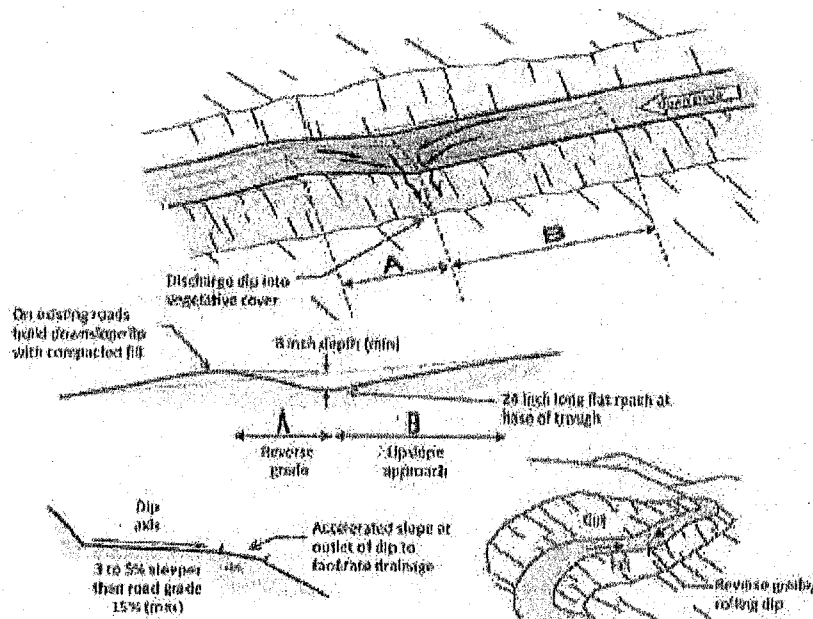
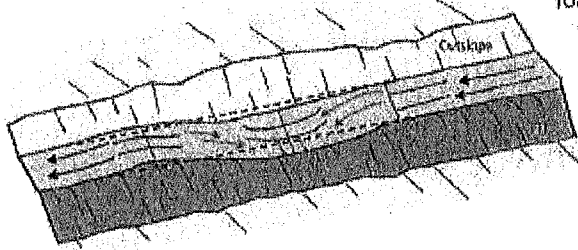


FIGURE 34. A classic Type I rolling dip, where the excavated up-road approach (B) to the rolling dip is several percent steeper than the approaching road and extends for 50 to 80 feet to the dip axis. The lower side of the structure reverses grade (A) over approximately 15 feet or more, and then falls 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 out-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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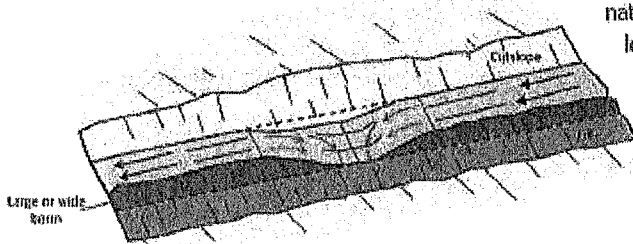
BMP: (Rocked) Rolling Dip (Cont.)

Type 1 Rolling Dip (Standard)



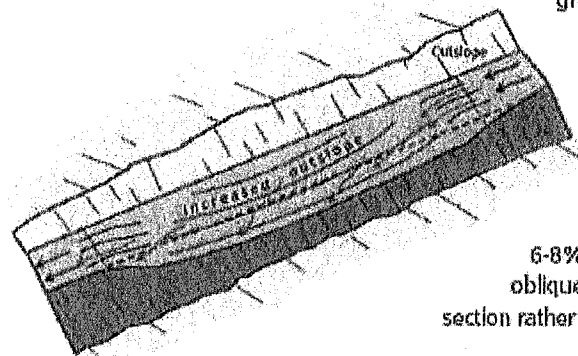
Type 1 rolling dips are used where road grades are less than about 12-14% and road runoff is not confined by a large through cut or berm. The axis of the dip should be perpendicular to the road alignment and sloped at 3-4% across the road tread. Steep roads will have longer and more abrupt dip dimensions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

HANDBOOK FOR FOREST, RANCH AND RURAL ROADS

BMP: Rolling Dips

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.

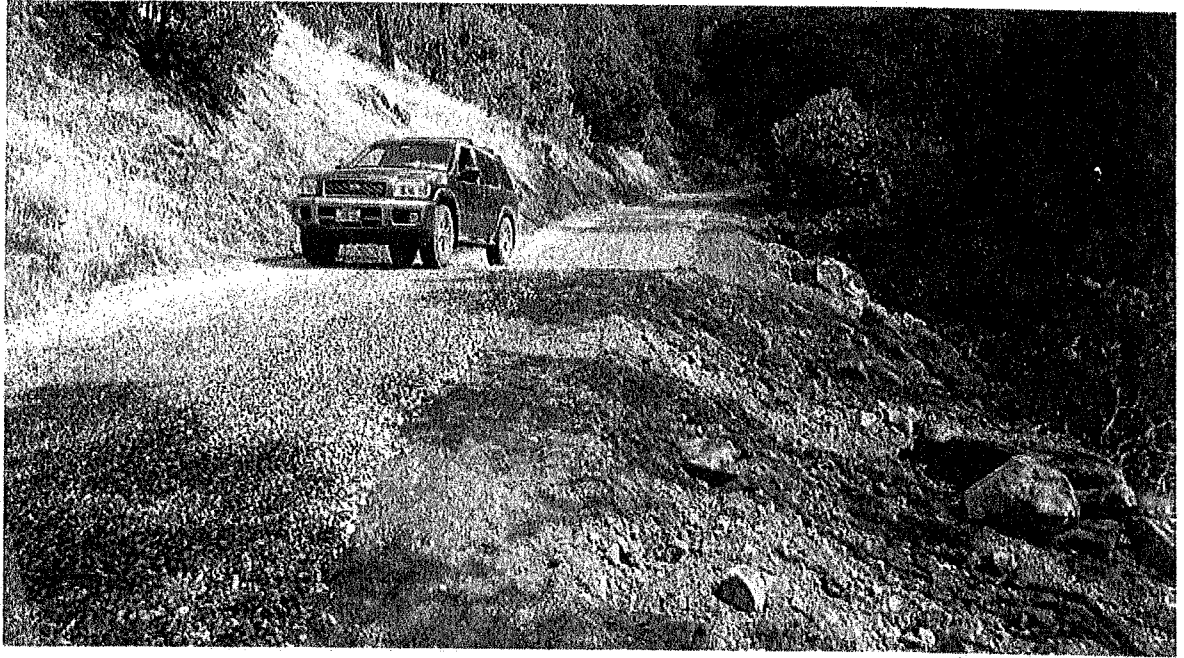


FIGURE 33B.

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: Unstable Fill Removal and Treatment

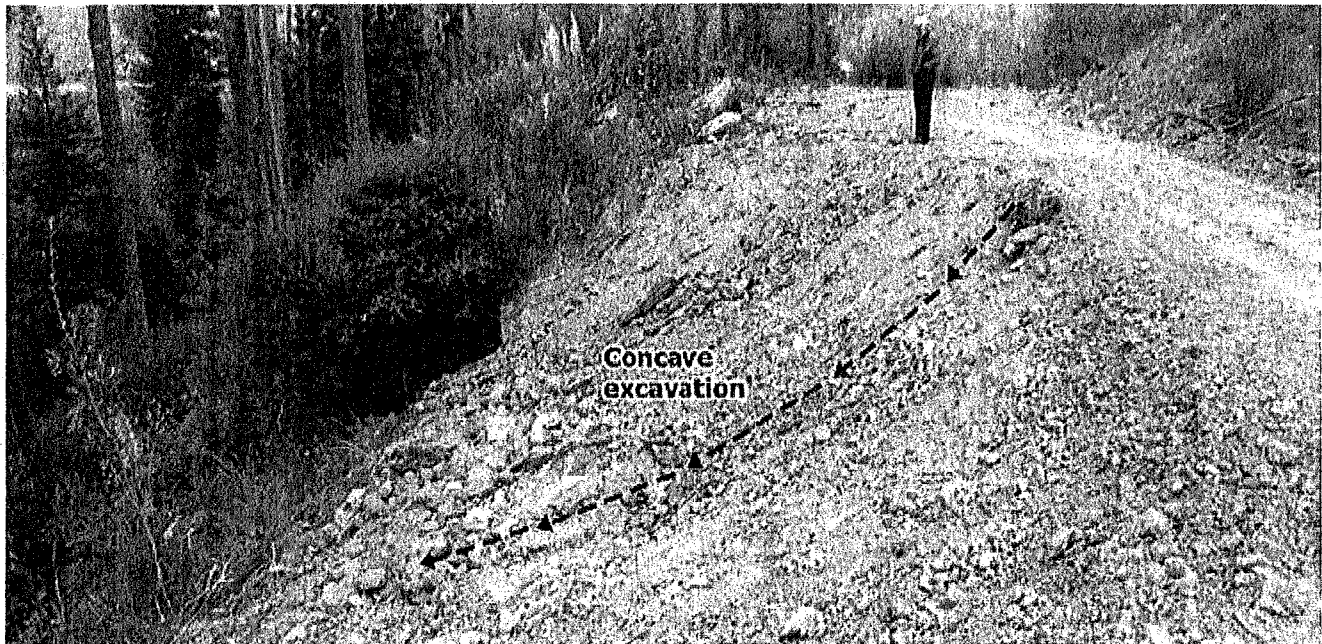
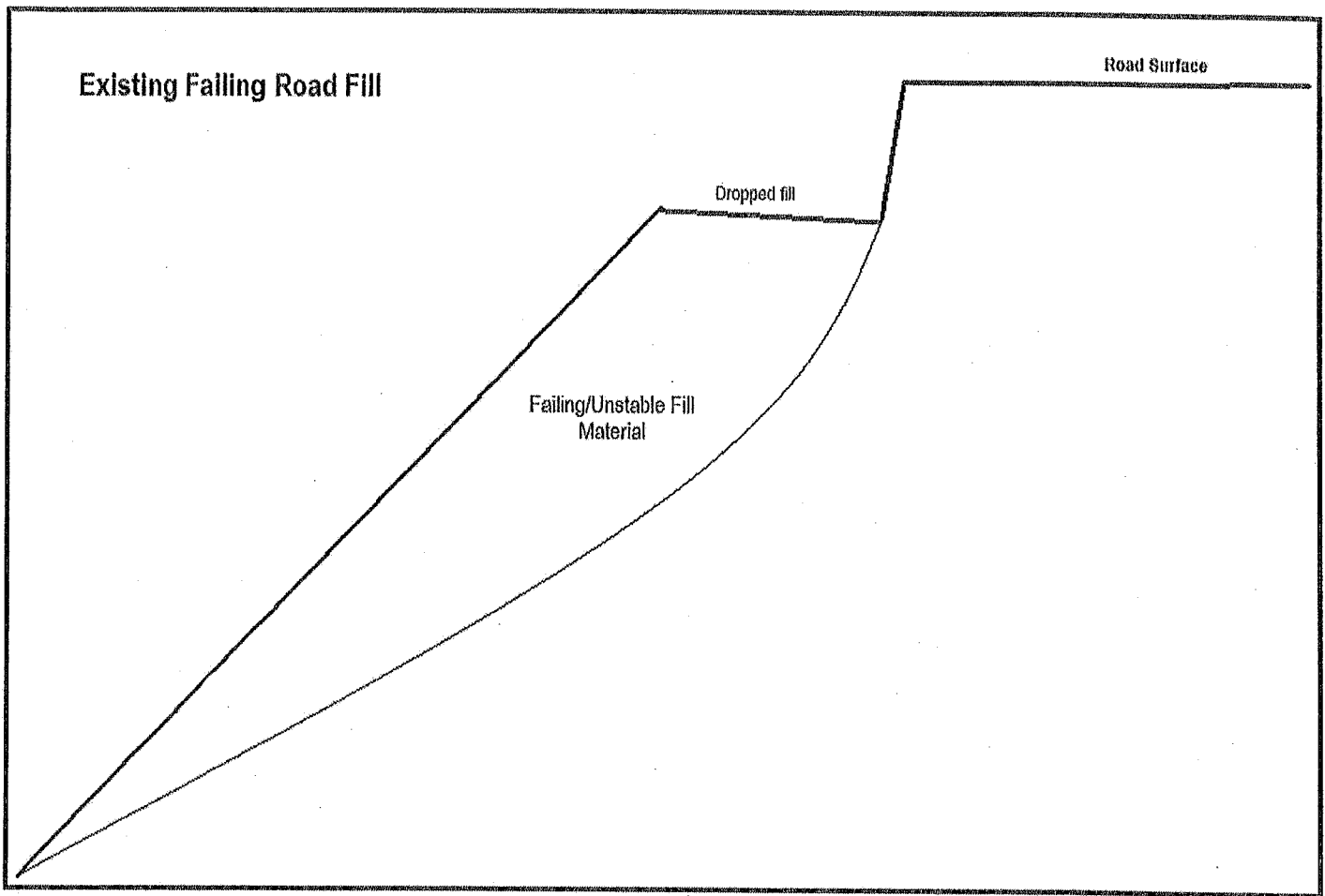
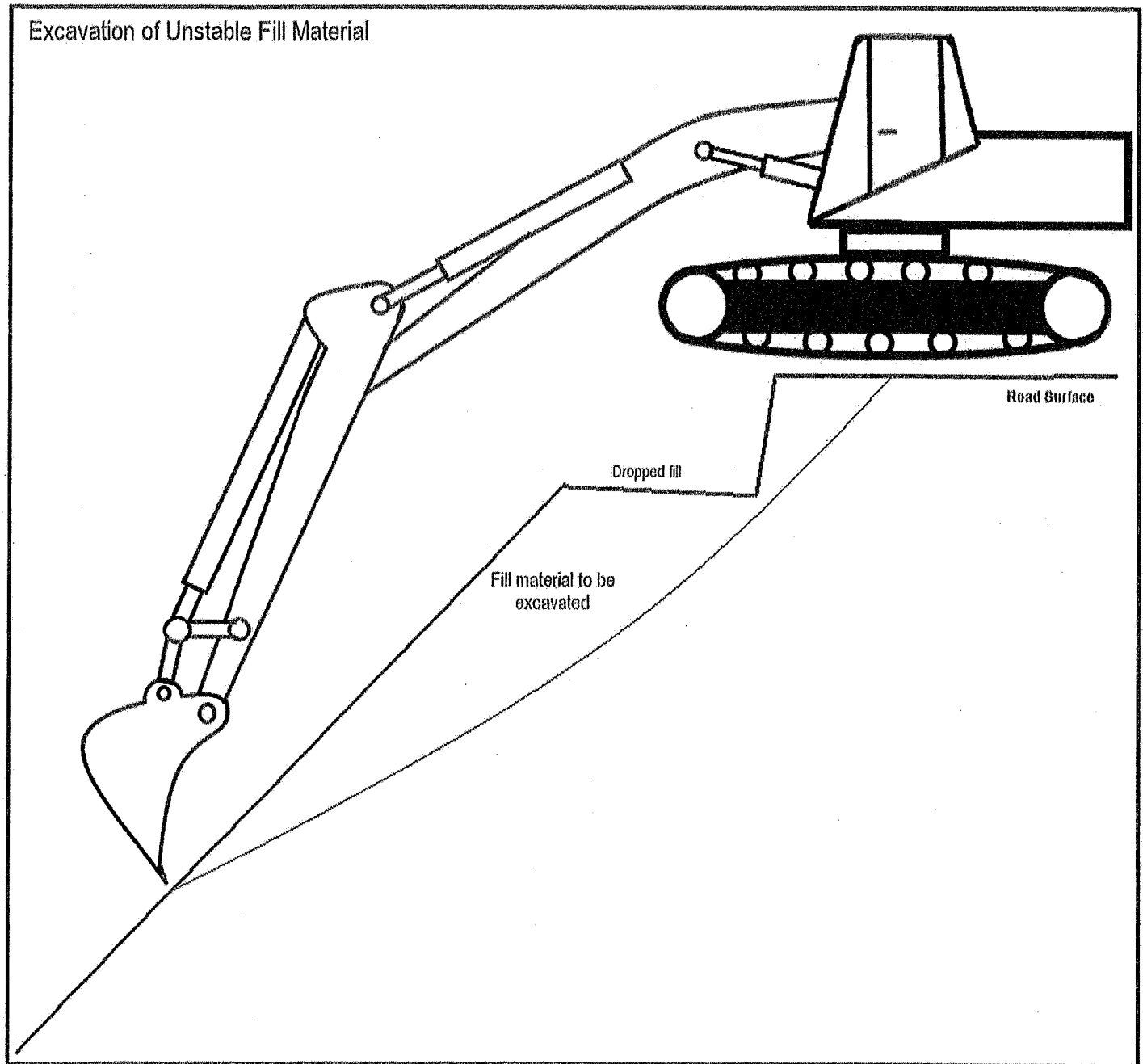


FIGURE 230. *The most cost-effective treatment for unstable fills along the outside of a forest, ranch or rural road is simply the direct excavation of the unstable material. If road width is too narrow, additional width can often be derived from cutting into the bank. The excavation should encompass 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 mid-sized excavator. Any remaining fill is likely to be small enough that it will not fail or travel far enough to reach the stream.*

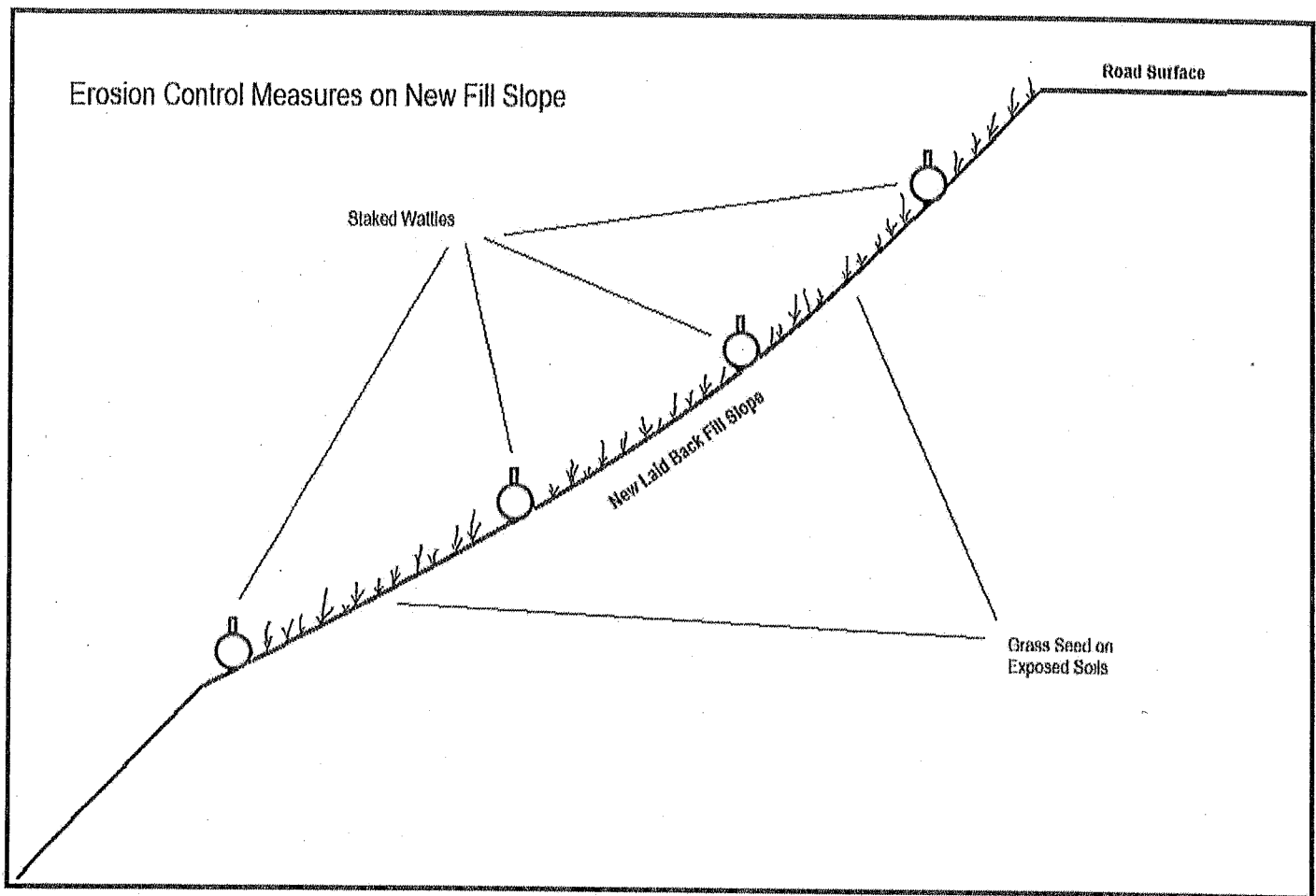
BMP: Unstable Fill Removal and Treatment



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.*