# Final Report:
# The Conservation Fund
# Garcia River Forest Phase 1 Assessment
# Mendocino County, California

PWA Report #08068303
March, 2008

**CDFG Fisheries Restoration Grant Program**
**Salmon and Steelhead Trout Restoration Account**
**Contract #P0430414**

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# 1 EXECUTIVE SUMMARY

The 24,000-acre "Garcia River Forest" is located within the Garcia River watershed, east of the town of Point Arena in Mendocino County, California. During 2006-07, Pacific Watershed Associates, Inc. (PWA), under contract to The Conservation Fund (TCF), conducted a sediment source assessment along a total of 102 mi of private timber access roads within their Garcia River Forest property, including 64 miles of roads in the Inman Creek and Indian Springs subwatersheds, and 38 mi of roads in the Signal Creek watershed. The assessment was funded by a California Department of Fish and Game (CDFG) Fisheries Restoration Grant (Contract #P0430414). This report summarizes the results of all assessment work undertaken in the Garcia River Forest Phase 1 Assessment Area, and includes summary reports for the Inman/Indian Springs and Signal Creek sub-watersheds of the Garcia River.

The assessment utilized upslope assessment methodologies described in the California Salmonid Stream Habitat Restoration Manual (CDFG, 2002). The goals of the assessment were to develop erosion control-and-erosion prevention plans which would, when implemented: 1) minimize the risk of future sediment delivery to streams by improving road surface drainage and upgrading or decommissioning road drainage structures to accommodate the 100-year storm discharge; and 2) provide recommendations for upgrading or decommissioning the inventoried roads.

The Garcia River Forest Phase 1 Assessment identified a total of 540 active or potential sediment delivery sites that could, if left untreated, deliver nearly 70,000 $yd^3$ of sediment to streams in the watershed. The predicted future erosion is associated with stream crossing erosion and stream diversions, fine sediment production from "hydrologically connected" road reaches, and road fill failures along the inventoried roads. Each of the 540 sites of potential sediment delivery was: 1) assigned a treatment immediacy based on the volume of future sediment delivery, likelihood of the erosion occurring in the near future, and several other factors; 2) prescribed for corrective measures to prevent or minimize future erosion; and 3) analyzed to develop estimated costs for implementing the recommended treatments.

We estimate that approximately $1.6 million will be needed to implement the erosion control and erosion prevention measures at the 419 specific sites recommended for treatment, and to minimize or eliminate the risk of future sediment delivery along nearly 30 miles of hydrologically connected roads.

In summer 2007, TCF and PWA commenced implementation of recommended erosion control and erosion prevention measures in the Inman Creek watershed under a CDFG Fisheries Restoration Grant (Contract #P0610511). Also in 2007, TCF applied to CDFG for further funding to begin implementation of erosion control-and-erosion prevention treatments in the Signal Creek watershed. This request was denied, but TCF plans to resubmit the proposal in May 2008.

## 2 CERTIFICATION AND LIMITATIONS

The report entitled *Final Report: The Conservation Fund Garcia River Forest Phase 1 Assessment*, was prepared under the direction of a licensed geologist at Pacific Watershed Associates, Inc. (PWA). All information provided in this report is based upon data and information collected by Pacific Watershed Associates.

The findings of this report are valid as of the report submittal date. However, changes in the conditions of the property can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside our control. Therefore, information contained in the report should be re-evaluated after a period of five years to be consistent with existing conditions if implemetation has not been initiated by TCF.

The interpretations and conclusion presented in this report are based on a study of inherently limited scope. Observations were qualitative, limited to surface expressions and limited natural and artificial exposures of subsurface materials. Interpretations of problematic hillslopes and erosion processes are typically based on the nature and distribution of existing features. For this reason, the conclusions should be considered limited in extent.

This report is issued with the understanding that it is the responsibility of the landowner, to ensure that the information and recommendations contained herein are reviewed and implemented according to the conditions at the time of construction. The conclusions and recommendations contained herein are professional opinions derived in accordance with current standards of professional practice. No other warranty expressed or implied is made.

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# 3 BACKGROUND

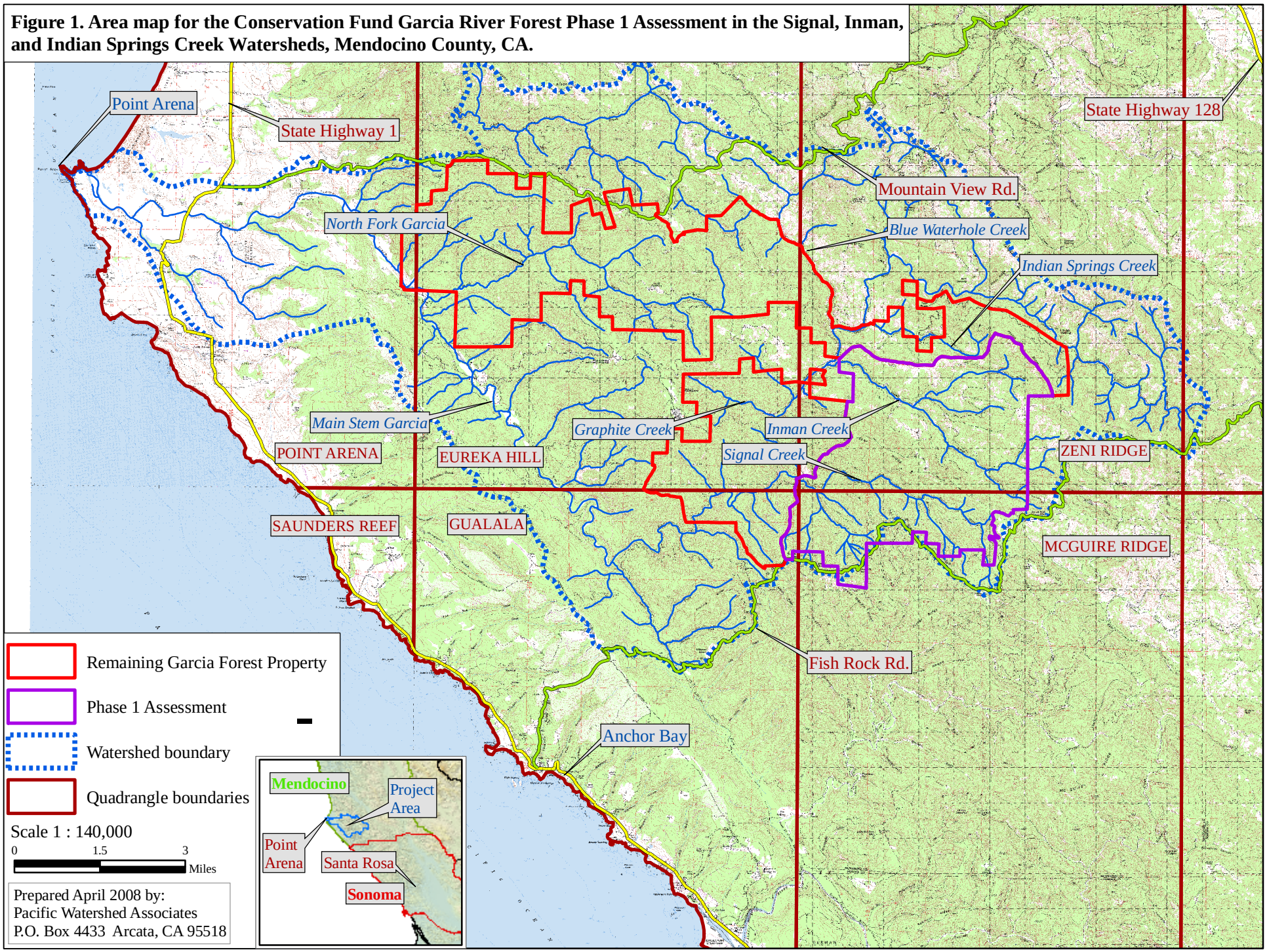
The Conservation Fund (TCF) has been an owner and manager of forestlands since 1995. Currently TCF has approximately 64,000 acres under active management in California, New York, Vermont and Virginia. In 2004, with the assistance of the State Coastal Conservancy, Wildlife Conservation Board and The Nature Conservancy, the largest addition to the TCF's timberland portfolio occurred with the purchase of the 24,000-acre "Garcia River Forest" (Figure 1). The goal of the purchase was to provide a demonstration project for sustainable forestry and watershed-scale erosion control in California's North Coast region.

The Garcia River Forest (GRF) is a prime example of coastal redwood forestland, located in the middle portions of the Garcia River watershed, in southern Mendocino County. The GRF encompasses approximately 90% of the land area of the Signal Creek, Inman Creek, North Fork Garcia River and Olsen Gulch subwatersheds. In addition, approximately 65% of the Graphite Creek and Indian Springs Creek subwatersheds and 35% of the Blue Waterhole Creek sub-watershed, along with numerous small unnamed subwatersheds, are included in the GRF (Figure 1). The highlight of the GRF property is the inclusion of 35 mi of fish-bearing streams that will provide critical refugia for the recovery of coho and fall chinook salmon, as well as steelhead trout within the North Coast region.

In 1994, the U.S. Environmental Protection Agency (EPA) listed the Garcia River watershed as impaired by excessive sediment. In 1997, the North Coast Regional Water Quality Control Board (NCRWQCB) undertook studies to determine the extent of the sedimentation impacts on aquatic habitat, the primary sediment production processes, how much sedimentation was caused by human activities and how much was controllable, and to develop numeric targets for reducing sediment production from the various land-use practices occurring throughout the watershed. In 1998 and 1999, the NCRWQCB, in cooperation with the Environmental Protection Agency (EPA), developed a "Total Maximum Daily Load" (TMDL) plan for the Garcia River basin (EPA, 1998), as well as the "Action Plan for the Garcia River Watershed Sediment TMDL", which is the TMDL implementation plan (NCRWQCB, 2001). The 2001 NCRWQCB Action Plan requires Garcia River landowners to develop either: 1) comprehensive ownership-wide erosion control plans, or 2) comprehensive site-specific erosion control plans, in order to begin the process of meeting the numeric targets established for sediment.

In May 2004, Chris Kelly, California Program Director for TCF, requested that PWA submit a watershed restoration and sediment assessment proposal to the California Department of Fish and Game (CDFG) Fisheries Restoration Grant Program. PWA proposed to 1) conduct sediment source investigations and develop prioritized erosion control and erosion prevention plans for the Signal and Inman/Indian Springs sub-watersheds of the Garcia River basin, and 2) conduct channel surveys along the lower main stem of both Signal and Inman Creeks to determine suitable locations for recruting and placing additional LWD in the channel. The proposal was accepted for funding, and PWA received a CDFG contract (Contract #P0430414) to perform the assessment in early 2006.

**Figure 1. Area map for the Conservation Fund Garcia River Forest Phase 1 Assessment in the Signal, Inman, and Indian Springs Creek Watersheds, Mendocino County, CA.**



In early 2006, PWA performed a historical aerial photo analysis of the Garcia River Forest Phase I Assessment area, which encompassed the Inman Creek, Indian Springs and Signal Creek subwatersheds. Existing and historical roads were identified and mapped, and analysis results were employed to identify roads to be inventoried in the field to identify existing and potential sites of erosion and sediment delivery to streams. Between July 2006 and November 2007, PWA conducted an evaluation of road-related erosion and sediment delivery along approximately 102 miles of road. A total of 64 mi of roads were surveyed within the Inman Creek and Indian Springs Creek watersheds, and 38 mi were surveyed within the Signal Creek watershed. All work was performed under the CDFG grant, as part of the Garcia River Forest Phase 1 Road Erosion Assessment.

Specifically, PWA's goals were to:

1) conduct a field assessment of potential and ongoing surface runoff patterns and erosion risk associated with approximately 20 mi of mainline timber haul roads and 82 mi of secondary haul roads of varying construction dates, maintenance histories and conditions,

2) develop a long-term, prioritized erosion control plan for each sub-watershed area, including recommended treatment prescriptions, typical construction drawings and cost estimates for controlling ongoing and future erosion both along the surveyed roads and on adjacent hillslopes. The cost estimate would include all heavy equipment, labor, material and technical oversight costs to implement the recommended long-term erosion control measures, and

3) compile the field data and prepare final reports for submittal to CDFG (as well as submitting the reports to NCRWQCB to meet TMDL requirements ancillary to CDFG project requirements).

The erosion assessment protocol developed by PWA and approved by CDFG, NCRWQCB, Army Corp of Engineers, and the National Marine Fisheries Service, was employed to identify sites of existing and potential erosion, to develop treatment prescriptions and prepare this report (Part X, CDFG, 2002). All recommended erosion control measures conform to guidance provided in the *Handbook for Forest and Ranch Roads* (PWA, 1994), and were done in accordance with the techniques and guidance described in the *California Salmonid Stream Habitat Restoration Manual, Chapters 9 and 10* (CDFG, 2002).

This report summarizes the results of all assessment work conducted in the Garcia River Forest Phase I Assessment. Attached to this cover report are three summary reports in Attachments A, B and C. Attachments A and B, respectively, are comprehensive site-specific and prioritized erosion control plans for upland areas within the Signal Creek and Inman/Indian Springs Creek watersheds, and meet both the requirements of the CDFG grant and NCRWQCB submittal requirements. Attachment C, prepared by Craig Bell, describes the results of channel surveys and recommendations for the placement of addition instream structures to improve habitat complexity.

# 4 LOCATION OF THE PROJECT

The Signal and Inman Creek watersheds are accessed from Highway 101 at Cloverdale by taking Highway 128 west toward Boonville. A few miles west of Yorkville, take a left turn onto County maintained Fish Rock Road (Figure 1). Travel west 12-13 miles to a right turn at gated, gravel logging roads (end of paved road) that access the watershed areas. From Highway 1, go north from Gualala through the town of Anchor Bay (Figure 1). Travel an additional mile up Highway 1 to a right turn onto Fish Rock Road. Go east up and over the hills for about 20 miles to a left turn at the same locked gates for access into the assessment area.

All TCF roads in the Phase 1 assessment area are unpaved private logging roads. The sub-basins inventoried for this project are in the south central portion of the Garcia River watershed, and consist of 90 to 95% of the land in the Signal Creek and Inman Creek Calwater Planning Watersheds (111.70020) and 111.70014). Signal Creek is located in T12N, R15W, Mount Diablo Meridian, Sections 11,12, 13, 14, 23, 24, 25, 26, 27, 34, 35 and 36. Inman Creek is located in T12N, R14W, Mount Diablo Meridian, Sections 4, 5, 6, 7, 8, 9, 10, 15, 16, 17, 18, 19, 20, 21, 22, 28, 29, 30 and 33. Signal and Inman Creeks are located at latitude: +38.883, and longitude: -123.454. The Conservation Fund is the legal owner of the Garcia Forest while the The Nature Conservancy holds a Conservation Easement on the property. The Fund can be reached at: The Conservation Fund, 14951 "A" Caspar Road, Box 50, Caspar, CA 95420, Attention: Jenny Griffin.

# 5 SUMMARY OF UPLAND ASSESSMENT RESULTS

## 5.1 Road Construction History and Transportation Planning

Prior to conducting the field assessment, an analysis of stereo aerial photographs from 1965, 1988, 1995 and 2004 was performed to determine the locations and extent of roads in the Garcia River Forest Phase 1 Assessment area. Working closely with TCF Forester Scott Kelly, and following TCF Draft Road Management Policies (Unpublished TCF, May 2007), preliminary transportation plans were developed for the Phase 1 Assessment area. The analysis determined which routes were likely candidates for either road upgrading and road decommissioning. Decommissioning recommendations were made with the understanding that new road locations and progressive road construction techniques will be required to access the adjacent hillslopes for future management activities. Results of the road construction history, as well as specific recommendations for upgrading and decommissioning, are contained in Attachments 1 and 2.

## 5.2 Sediment Source Assessment

PWA inventoried a total of 540 sites of ongoing or potential sediment delivery to streams in the Garcia River Forest Phase 1 Assessment area. Details on site types, potential sediment delivery volumes and lengths of hydrologically connected road for each sub-watershed area are contained in the sub-watershed reports (Attachments 1 and 2), and summarized in Tables 1 and 2 of this cover letter report.

Inventoried sites included a total of 416 stream crossings, of which 315 were recommended for treatment (Table 1). Nearly 38,000 $yd^3$ of future sediment delivery can be saved over several decades by implementing the suggested road upgrading or road decommissioning measures at the stream crossing sites (Table 2). Specifics on the types of stream crossing sites assessed, including details on stream crossing drainage structures and data summarizing estimated future sediment delivery volume, erosion potential and diversion potential are also contained in Attachments 1 and 2.

Of the existing or potential future landslide sites observed in the field, only those sites with a potential for sediment delivery to a stream channel were inventoried. A total of 32 landslides or potential fill failures were identified during the assessment. Of these, 23 were recommended for treatment. Potential fillslope landslides are expected to deliver over 7,300 $yd^3$ of sediment to the Garcia River and its tributaries in the future (Table 2, Attachments 1 and 2).

A total of 92 sites are listed in the "other" section of Table 1, and we recommended treatment at 81 of these sites. We estimate that these sites together will generate over 1,800 $yd^3$ of future sediment delivery if they are not treated (Table 2).

Hydrologically connected road segments deliver fine sediment to streams on a chronic, ongoing basis. Chronic sediment delivery occurs through a combination of 1) cutbank erosion delivering sediment to the ditch (triggered by dry ravel, rainfall, freeze-thaw processes, cutbank slides and brushing practices), 2) inboard ditch erosion and sediment transport, 3) mechanically pulverizing and wearing down the road surface during dry periods due to vehicular use, and 4) erosion of the road surface during wet weather periods, when virtually every vehicle pass entrains sediment that can be transported to inboard ditches and gullies, and thence to nearby streams.

Currently, a total of 33.3 mi of road (33% of the total surveyed road length) is hydrologically connected and delivers road bed-derived runoff and sediment to streams (Table 1). Of this, we have recommended road drainage treatments for nearly 30 mi, which potentially could reduce the delivery of fine sediment to streams within the Garcia River watershed by over 22,000 $yd^3$ over the next ten years. Details on calculations of future sediment delivery volumes from connected road reaches can be found in the sub-watershed reports in Attachments 1 and 2.

Improving road drainage design and treating potential erosion and sediment delivery sites as proposed throughout the Garcia River Forest Phase 1 Assessment area could prevent a total of over 69,000 $yd^3$ of future sediment delivery to streams over several decades (Table 2), as well as lessen future road maintenance requirements along the affected roads.

**Table 1.** Inventory results and treatment recommendations for sediment delivery sites and hydrologically connected road segments, TCF Garcia River Forest Phase 1 Assessment, Mendocino County, California.

| Type of sediment delivery site | Sediment delivery sites | | Hydrologically connected roads | | Total roads surveyed (mi) |
|---|---|---|---|---|---|
| | Inventoried (#) | Recommended for treatment (#) | Inventoried (mi) | Recommended for treatment (mi) | |
| Stream crossing | 416 | 315 | 25.3 | 22.2 | - |
| Landslide | 32 | 23 | 1.0 | 0.8 | - |
| Other[a] | 92 | 81 | 7.0 | 6.7 | - |
| **Total** | **540** | **419** | **33.3** | **29.7** | **102** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.

**Table 2.** Estimated future sediment delivery for sites and road surfaces recommended for treatment, TCF Garcia River Forest Phase 1 Assessment, Mendocino County, California.

| Sources of sediment delivery | Estimated future sediment delivery ($yd^3$) | Percent of total |
|---|---|---|
| Stream crossings | 37,928 | 55% |
| Landslides | 7,305 | 11% |
| Other sites[a] | 1,827 | 2% |
| Hydrologically connected road and cutbank surfaces adjacent to sediment delivery sites[b] | 22,208 | 32% |
| **Total** | **69,268** | **100%** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.
[b]Decadal sediment delivery for unsurfaced roads, assuming a 25 ft wide road surface and cutbank contributing area, and 0.2 ft lowering of road and cutbank surfaces per decade on drive roads, and 0.1 ft on all other roads.

## 6 TREATMENT PRIORITY

This erosion assessment is intended to provide information to guide long-range transportation planning, as well as identify and prioritize erosion prevention and erosion control activities along the assessed roads within the Phase 1 Assessment area. As a result, not all of the sites that have been recommended for treatment have the same priority. Treatment priorities are evaluated on the basis of several factors and conditions associated with each potential erosion site.

These include:

(1) the expected volume of sediment to be delivered to a stream;

(2) the potential for future erosion (high, moderate, low);

(3) the urgency of treating the site (treatment immediacy);

(4) the ease and cost of accessing the site for treatment; and

(5) the logistics and costs of recommended treatments.

Sediment delivery sites have been classified by number, type, treatment immediacy, and the total future erosion volume attributed to each treatment immediacy group (Table 3). The location of each site, according to treatment immediacy, can be found on maps provided with the sub-watershed reports (Attachments 1 and 2).

## 7 TREATMENTS

The general types of corrective measures recommended along the assessed roads in the Garcia River Forest Assessment area are contained in the sub-watershed reports (Attachments 1 and 2). Individual data forms for each of the 540 mapped sites of potential sediment delivery have been compiled in a Microsoft Access database. The detailed treatments at each site are described on the data forms and in the database. Appendix A of each sub-watershed report (see Attachments A and B) provides a summary of site conditions and treatment recommendations at each site. Typical construction diagrams for each type of treatment category are shown in Appendix B of each sub-watershed report (see Attachments A and B).

## 8 IMPLEMENTATION COST ESTIMATE

Table 4 summarizes all costs to implement the recommended erosion control treatments along the surveyed roads within the entire Garcia River Forest Phase 1 Assessment area. The cost estimate is separated into 4 parts: 1) the total heavy equipment and labor costs, including equipment move-in and move-out costs, to treat all recommended sites within the Phase 1 assessment area, 2) the costs for materials to complete the project; primarily culverts, riprap and road rock, 3) the costs for PWA to provide technical guidance and overall project management of the work, and 4) a determination of the project cost-effectiveness, calculated by dividing the total estimated project cost by the estimated potential sediment savings. We estimate that approximately $1.58 million is needed to complete the recommended treatments in the Garcia River Forest Phase 1 Assessment area. This equates to an estimated cost-effectiveness of $22.87 per cubic yard of sediment saved.

**Table 3.** Treatment immediacy ratings for all sites recommended for erosion control treatment in TCF Garcia River Forest Phase 1 Assessment area, Mendocino County, California.

| Treatment immediacy | Number of upgrade sites | Number of decommission sites | Number of treatment sites by type[a] | Estimated future sediment delivery[b] ($yd^3$) | Percent of total |
|---|---|---|---|---|---|
| High | 11 | 5 | 12 stream crossing, 1 landslide, 3 other | 7,915 | 11% |
| High-moderate | 30 | 33 | 54 stream crossing, 2 landslide, 7 other | 15,690 | 23% |
| **Subtotal for high + high-moderate: 23,605** | | | | | **34%** |
| Moderate | 63 | 51 | 83 stream crossing, 8 landslide, 23 other | 22,125 | 32% |
| Moderate-low | 60 | 60 | 86 stream crossing, 4 landslide, 30 other | 16,361 | 24% |
| **Subtotal for moderate + moderate-low: 38,486** | | | | | **56%** |
| Low | 33 | 73 | 80 stream crossing, 8 landslide, 18 other | 7,176 | 10% |
| **Total** | **199** | **220** | **315 stream crossing, 23 landslides, 81 other** | **69,268** | **100%** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.
[b]*Estimated future sediment delivery* includes sediment delivered from treatment sites and any adjacent hydrologically connected road reaches.

## 9 ITEMIZED ASSESSMENT BUDGET

Table 5 provides an itemization of how CDFG grant monies and TCF cost share funding was expended to complete the project. At total of $162,225 was required to complete the project, of which $145,175 was provided by CDFG and $17,050 was provided by TCF as a cash cost share (Table 5). Field work to complete the project occurred between July 2006 and November 2007. Data analysis occurred throughout the project. The Inman Creek and Indian Springs watershed report was submitted to TCF in February 2007, and the final report for the full Phase 1 Assessment was submitted to CDFG in April 2008.

**Table 4.** Estimated equipment times and costs to implement erosion control and erosion prevention treatments, TCF Garcia River Forest Phase 1 Assessment area, Mendocino County, California.

| Cost category[a] | | Cost rate[b] ($/hr) | Estimated Project Times | | | Total estimated costs[e] ($) |
|---|---|---|---|---|---|---|
| | | | Treatment[c] (hr) | Logistics[d] (hr) | Total (hr) | |
| Move in, move out[f] | Excavator | 100 | 18 | -- | 18 | 1,800 |
| | Bulldozer | 100 | 18 | -- | 18 | 1,800 |
| | Grader | 100 | 18 | -- | 18 | 1,800 |
| | Loader | 100 | 12 | -- | 12 | 1,200 |
| | Water truck | 100 | 18 | -- | 18 | 1,800 |
| Road opening | Excavator[g] | 125/130 | 50 | -- | 50 | 6,375 |
| | Bulldozer | 95 | 80 | -- | 80 | 7,300 |
| Heavy equipment for site-specific treatments[h] | Excavator | 125/130 | 2,065 | 619 | 2,684 | 340,425 |
| | Bulldozer | 95 | 1,986 | 526 | 2,582 | 245,290 |
| | Dump truck | 85 | 510 | 153 | 663 | 56,355 |
| | Loader | 90 | 60 | 18 | 78 | 7,020 |
| | Water truck | 85 | 217 | 65 | 282 | 23,970 |
| | Truck/trailer | 50 | 43 | 13 | 56 | 2,800 |
| Heavy equipment for road drainage treatments[i] | Excavator | 125/130 | 222 | 67 | 289 | 36,785 |
| | Bulldozer | 95 | 948 | 286 | 1,234 | 117,230 |
| | Water truck | 85 | 268 | 81 | 349 | 29,665 |
| | Grader | 125 | 155 | 47 | 202 | 20,750 |
| Laborers[j] | | 45 | 1,320 | 396 | 1,716 | 77,220 |
| Rock costs (includes trucking for 584 $yd^3$ of road rock and 1,249 $yd^3$ of riprap) | | | | | | 46,190 |
| Culvert materials costs (2,500' of 18", 3,890 of 24", 1,200' of 30", 260' of 36", 70' of 42", 230' of 48", 240' of 54", 90' of 60", and 150' of 72", including costs for couplers and elbows) | | | | | | 222,559 |
| Bridge materials (1 flatcar bridge) | | | | | | 25,000 |
| Mulch, seed, and planting materials for 33.5 acres of disturbed ground[k] | | | | | | 18,920 |
| Supervision, coordination, layout, and reporting[l] | | | | | | 291,510 |
| **Total estimated costs: $1,584,064**<br>**Potential sediment savings: 69,268 $yd^3$**<br>**Overall project cost-effectiveness: $22.87 spent per cubic yard of sediment saved** | | | | | | |

**(Continued on next page.)**

**Table 4—continued.**

[a]Costs excluded from the list are for (1) tools and miscellaneous materials, (2) variable administration and contracting expenses, and (3) CEQA and permitting costs.
[b]Heavy equipment costs include operator and fuel. Costs listed are estimates for favorable local private sector equipment rental and labor rates.
[c]Treatment times refer to equipment hours expended explicitly for erosion control and erosion prevention work at all project sites and roads.
[d]Logistics times for heavy equipment (30%) include all equipment hours expended for opening access to sites on maintained and abandoned roads, travel time for equipment to move from site to site, conference times with equipment operators to convey treatment prescriptions and strategies, and an inflation factor. Logistic times for laborers (30%) include estimated daily travel time to project area.
[e]Total estimated project costs for equipment rental and labor are based on private sector rates at prevailing wage. Materials costs are subject to change.
[f]Lowboy hauling costs are based on 3 hauls each (1 to move in and 1 to move out) at 6 hr/trip, for excavator, bulldozer, grader, and water truck, and 2 hauls for loader.
[g]Excavator costs are based on $125/hr for costs estimated in 2006, and $130/hr for costs estimated in 2007.
[h]An additional 12 hours of excavator and dump truck time are added for import of clean fill at upgraded stream crossing sites. An additional 23 hr of truck and trailer time are added for delivering straw to sites. A total of 20 hr of truck and trailer time and 20 hr of loader time are added for delivering culverts.
[i]An additional 23 hours of bulldozer time have been added for decommission outsloping of 11,315 ft of Lower Signal Creek Road, and an additional 40 hr of water truck time and 40 hr of grader time are added for final grading and spreading road rock.
[j]An additional 117 hr of labor time are added for spreading straw mulch and seeding. This includes 23 hr of labor for initial delivery of straw to sites.
[k]Seed costs are based on 35 lb of native seed per acre at $9.75/lb. Straw needs are 50 bales per acre at $6.95/bale.
[l]Supervision time includes detailed layout (flagging, etc) prior to equipment arrival, training of equipment operators, supervision during equipment operations, supervision of labor work, and post-project documentation and reporting.

## 10 CONCLUSION

With the completion of the Phase 1 assessment along 102 miles of roads in the Signal, Inman and Indian Springs watersheds, and with thanks to the CDFG, an important and significant first step toward protecting and recovering salmonid habitat has been completed within a portion of The Conservation Fund Garcia River Forest. The systematic sediment source inventory, based on scientifically sound geomorphic and hydrologic principles, resulted in the identification and prioritization of virtually all the active and potentially controllable sources of future erosion and sediment delivery in the assessment area. A total of over 69,000 $yd^3$ of predicted future sediment delivery is likely to occur over the next several decades if the recommended erosion control and erosion prevention measures are not undertaken in a timely manner. PWA and TCF are committed to securing in-house and outside funding to implement the Phase 1 upland erosion control measures, as well as the recommended stream habitat restoration projects outlined in this plan.

The 100 $mi^2$ Garcia River watershed is a unique watershed in northern and central California. First, it has minimal to non-existent levels of non-forest management activities (i.e., subdivisions roads, water extraction, dams, septic systems, etc.) compared to most other north coast watersheds. Secondly, the progressive and sustainable forest practices being applied by TCF and The Nature Conservancy on The Garcia River Forest property, combined with the moderate strength of the existing wild fish runs, suggests the watershed offers one of the better opportunities to protect existing wild salmon and steelhead runs. The combination of

comparatively aggressive upland erosion control work, sustainable forest practices, and opportunistic improvements to instream habitat and stream channel complexity will both protect and improve salmonid habitat in this refugia system.

The completion of the Phase 1 Assessment of roads in the newly formed Garcia River Forest responds directly to several previously identified watershed-wide needs. Specifically, The Garcia River Watershed Enhancement Plan (Mendocino RCD, 1992) defined sediment problems related to roads and upland forest management and recommended the implementation of erosion control projects to reduce sediment yield. Bell (2003) noted progress on sediment abatement in the Garcia River basin, but also noted that some sub-basins, such as Inman and Signal Creek, had continuing problems that were not being addressed. Finally, in the Recovery Strategy for California Coho Salmon the proposed project addresses portions of the following items:

MC-GA-11: Maintain the following tributaries to provide cold water input to the Garcia River mainstem, and

MC-GA-06: Utilize as a model for erosion reduction and LWD placement the comprehensive approach applied in the South Fork Garcia River.

MC-GA-21: Place large woody debris in Signal and Inman Creeks [This project element is the planning stages].

MC-GA-14: Protect and enhance riparian buffers through conservation planning and acquisition [implementation of recommendations in the upland erosion assessment will lead to some level of road decommissioning in riparian zones].

## 11 REFERENCES

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**Table 5.** Final budget itemizing expenditures to complete the TCF Garcia River Forest Phase 1 Assessment, Mendocino County, CA.

| **TOTAL BUDGET: CDFG: $145,175, & The Conservation Fund: $17,050 =TOTAL $162,225** | | | | | |
|---|---|---|---|---|---|
| **Personnel Costs:** | | | | | |
| PERSONNEL | # OF HOURS | HOURLY RATE | CDFG[1] | THE CONSERVATOIN FUND[1] | PROJECT TOTALS[1] |
| Lead Professional | 164.75 | 52.50 | 7,456 | 1,194 | 8,650 |
| Project Geologist | 394.75 | 45.50 | 15,732 | 2,230 | 17,962 |
| Staff Geologist | 2,202.50 | 31.50 | 62,087 | 7,292 | 69,379 |
| GIS Specialist | 33.75 | 31.5 | 1,063 | 0 | 1,063 |
| Staff Benefits (30% of PWA personnel costs) | | | 25,901 | 3,215 | 29,116 |
| **Sub-Total Personnel Costs** | | | **112,239** | **13,931** | **126,170** |
| | | | | | |
| **Operating Expenses:** | | | | | |
| Subcontractor LWD Surveyor | 89.50 | 45 | 4,027 | 0 | 4,027 |
| Transportation | 9,359 | 0.34 | 2,963 | 219 | 3,182 |
| Lodging | 82 | 70 | 5,320 | 420 | 5,740 |
| Per Diem | 147 | 40 | 5,400 | 480 | 5,880 |
| Printing, Duplication, Map Supplies, Photographic Supplies | | | 777 | 0 | 777 |
| Field Supplies (Flagging, stakes, paint, hand tools) | | | 601 | 143 | 744 |
| Quad Rental | 38 | 25 | 650 | 300 | 950 |
| **Subtotal Operating Expenses** | | | **19,738** | **1,562** | **21,300** |
| Administrative Overhead (10%) incl. Worker Comp., Business Insurances, Rents, Comm. Contract Admin., Equip. Rental, & Misc. Expenses | | | 13,198 | 1,549 | 14,747 |
| **Total Funds Expended** | | | **145,174** | **17,042** | **162,216** |
| **Total Estimated Budget** | | | **145,175** | **17,050** | **162,225** |
| **Budget not spent** | | | **1** | **8** | **9** |

[1]Dollar amounts are rounded to the nearest whole dollar.

# Attachment A.

## Long Term Road Drainage and Erosion Control Plan for the Signal Creek Watershed, The Conservation Fund Garcia River Forest Phase 1 Assessment, Mendocino County, California

PWA Report #08068302
March, 2008

**CDFG Fisheries Restoration Grant Program**
**Salmon and Steelhead Trout Restoration Account**
**Contract #P0430414**

# Long Term Road Drainage and Erosion Control Plan for the Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California

PWA Report #08068302
March, 2008

**CDFG Fisheries Restoration Grant Program**
**Salmon and Steelhead Trout Restoration Account**
**Contract #P0430414**

*Prepared for:*
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# 1 EXECUTIVE SUMMARY

The 24,000-acre "Garcia River Forest" is located within the Garcia River watershed, east of the town of Point Arena in southwestern Mendocino County, California. During 2006-07, Pacific Watershed Associates, Inc. (PWA), under contract to The Conservation Fund (TCF), conducted a sediment source assessment along a total of 102 mi of private timber access roads within their Garcia River Forest property. The Inman Creek and Indian Springs subwatersheds of the Garcia River were assessed during 2006, and a summary report on this assessment was delivered to TCF in February 2007. In late 2007, PWA completed assessment of approximately 38 mi of roads in the Signal Creek watershed. This report presents the results of that road assessment.

The assessment utilized California Department of Fish and Game (CDFG)-approved upslope assessment methodologies, as described in the California Salmonid Stream Habitat Restoration Manual (CDFG, 2002). The goals of the assessment were to develop an erosion control-and-prevention plan which would, when implemented: 1) substantially reduce or minimize the risk of future sediment delivery to nearby streams by improving road surface drainage and upgrading or decommissioning road drainage structures to accommodate the 24-hour, 100-year storm discharge (ie., to conform with current NOAA Fisheries, Cal Fire, CRWQCB and CDFG standards); and 2) provide recommendations for upgrading or decommissioning the inventoried roads.

The Signal Creek field inventory identified 132 active or potential sediment delivery sites that could deliver, if left untreated, approximately 25,300 $yd^3$ of sediment to nearby streams over several decades. The predicted future erosion is associated with stream crossing erosion and stream diversions, fine sediment production from "hydrologically connected" road reaches, and fill failure landslides along the inventoried roads. Each of the 132 sites of potential sediment delivery was: 1) prioritized for treatment based on the volume of future sediment delivery, likelihood of the erosion occurring in the near future, and several other factors; 2) prescribed with corrective measures to prevent or minimize future erosion, such as installing new, larger culverts, outsloping roads (with and without inboard ditches), constructing rolling dips, decommissioning stream crossings, de-watering gullies, etc.; and 3) analyzed to develop estimated costs for implementing the recommended treatments.

We estimate a total of $655,369 will be needed to implement the erosion control and erosion prevention plan at the 111 sites recommended for treatment, and to minimize the risk of future sediment delivery along the 11.5 mi of hydrologically connected roads. In May 2007, TCF and PWA submitted an application to the CDFG Fisheries Restoration Grant Program to perform the recommended erosion control and erosion prevention measures at 63 identified sediment delivery sites along 8.9 mi of Signal Creek roads. This request was denied, but TCF plans to resubmit the proposal in May 2008.

## 2 CERTIFICATION AND LIMITATIONS

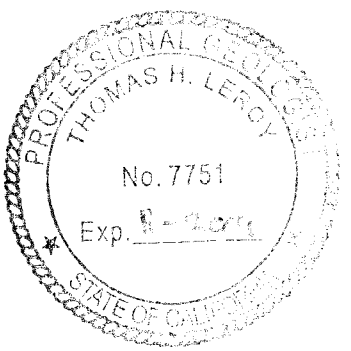
The report entitled *Long-Term Road Drainage and Erosion Control Plan for the Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment*, was prepared under the direction of a licensed geologist at Pacific Watershed Associates, Inc. (PWA). All information provided in this report is based upon data and information collected by Pacific Watershed Associates.

The findings of this report are valid as of the report submittal date. However, changes in the conditions of the property can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated, wholly or partially, by changes outside our control. Therefore, information contained in the report should be re-evaluated after a period of five years to be consistent with existing conditions if implemetation has not been initiated by TCF.

The interpretations and conclusions presented in this report are based on a study of inherently limited scope. Observations were qualitative, limited to surface expressions and limited natural and artificial exposures of subsurface materials. Interpretations of problematic hillslopes and erosion processes are typically based on the nature and distribution of existing features. For this reason, the conclusions should be considered limited in extent.

This report is issued with the understanding that it is the responsibility of the landowner, to ensure that the information and recommendations contained herein are reviewed and implemented according to the conditions at the time of construction. The conclusions and recommendations contained herein are professional opinions derived in accordance with current standards of professional practice. No other warranty expressed or implied is made.

Prepared by:

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# 3 BACKGROUND

The Conservation Fund (TCF) has been an owner and manager of forestlands since 1995. Currently TCF has approximately 64,000 acres under active management in California, New York, Vermont and Virginia. In 2004, with the assistance of the State Coastal Conservancy, Wildlife Conservation Board and The Nature Conservancy, the largest addition to the TCF's timberland portfolio occurred with the purchase of the 24,000-acre "Garcia River Forest". The goal of the purchase was to provide a demonstration project for sustainable forestry and watershed-scale erosion control in California's North Coast region.

The Garcia River Forest (GRF) is a prime example of coastal redwood forestland, located in the middle portions of the Garcia River watershed, in southern Mendocino County. The GRF encompasses approximately 90% of the land area of the Signal Creek, Inman Creek, North Fork Garcia River and Olsen Gulch subwatersheds. In addition, approximately 65% of the Graphite Creek and Indian Springs Creek subwatersheds and 35% of the Blue Waterhole Creek sub-watershed, along with numerous small unnamed subwatersheds, are included in the GRF (Figure 1). The highlight of the GRF property is the inclusion of 35 mi of fish-bearing streams that will provide critical refugia for the recovery of coho and fall chinook salmon, as well as steelhead trout within the North Coast region.

In 1994, the U.S. Environmental Protection Agency (EPA) listed the Garcia River watershed as impaired by excessive sediment. In 1997, the North Coast Regional Water Quality Control Board (NCRWQCB) undertook studies to determine the extent of the sedimentation impacts on aquatic habitat, the primary sediment production processes, how much sedimentation was caused by human activities and how much was controllable, and to develop numeric targets for reducing sediment production from the various land-use practices occurring throughout the watershed. In 1998 and 1999, the NCRWQCB, in cooperation with the Environmental Protection Agency (EPA), developed a "Total Maximum Daily Load" (TMDL) plan for the Garcia River basin (EPA, 1998), as well as the "Action Plan for the Garcia River Watershed Sediment TMDL", which is the TMDL implementation plan (NCRWQCB, 2001). The 2001 NCRWQCB Action Plan requires Garcia River landowners to develop either: 1) comprehensive ownership-wide erosion control plans, or 2) comprehensive site-specific erosion control plans, in order to begin the process of meeting the numeric targets established for sediment.

This report summarizes the results of assessment work conducted in the Signal Creek subwatershed of the Garcia River, and is intended to serve as a comprehensive site-specific and prioritized erosion control plan for the Signal Creek watershed, intended to meet The Conservation Fund's TMDL submittal requirements to the NCRWQCB.

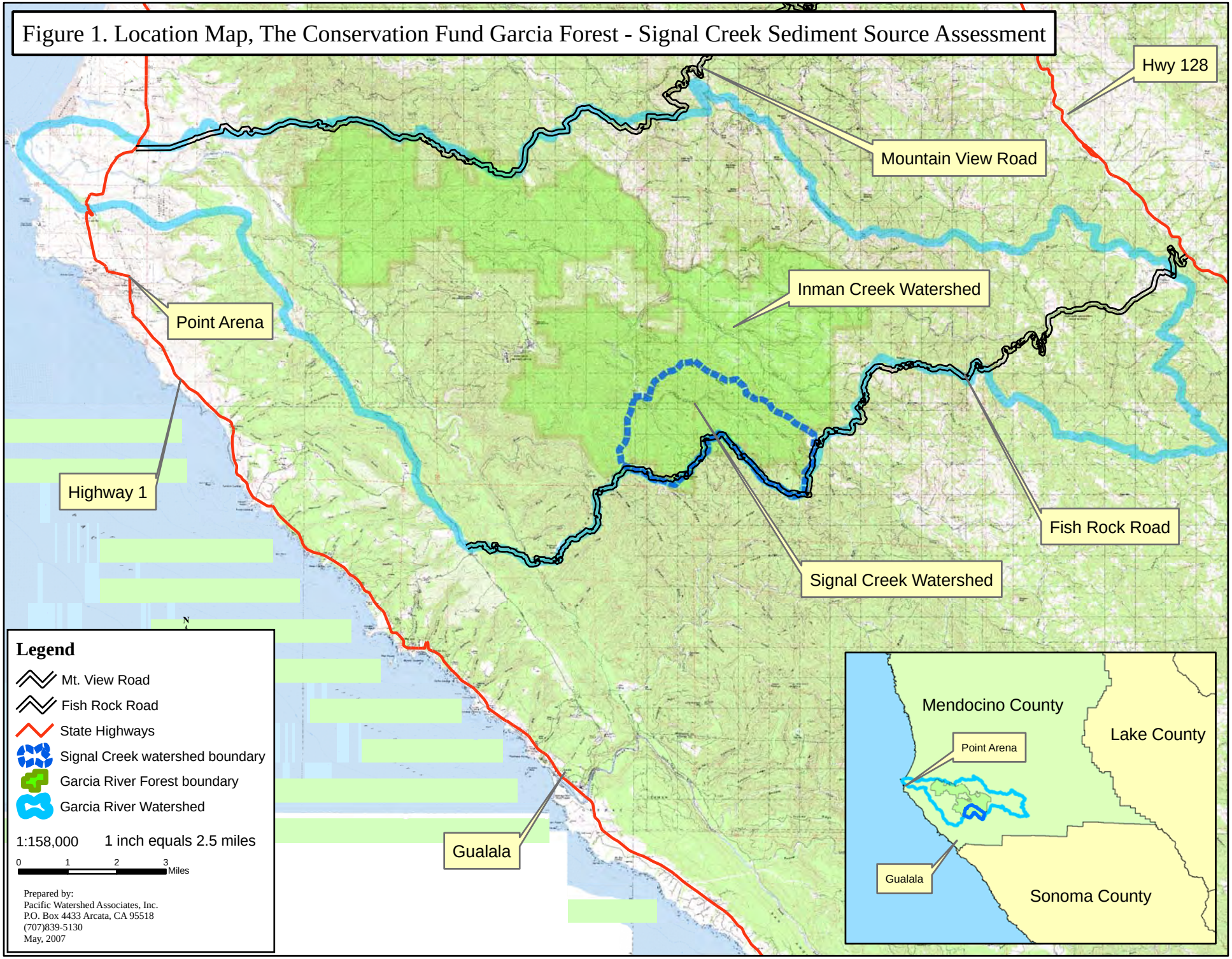
Figure 1. Location Map, The Conservation Fund Garcia Forest - Signal Creek Sediment Source Assessment
Hwy 128
Mountain View Road
Inman Creek Watershed
Point Arena
Highway 1
Fish Rock Road
Signal Creek Watershed
Gualala
Legend
Mt. View Road
Fish Rock Road
State Highways
Signal Creek watershed boundary
Garcia River Forest boundary
Garcia River Watershed
1:158,000
1 inch equals 2.5 miles
0 1 2 3 Miles
Prepared by:
Pacific Watershed Associates, Inc.
P.O. Box 4433 Arcata, CA 95518
(707)839-5130
May, 2007
Mendocino County
Lake County
Point Arena
Gualala
Sonoma County

# 4 SCOPE OF SERVICES

In May 2004, Chris Kelly, California Program Director for TCF, requested that PWA submit a watershed restoration and sediment assessment proposal to the CDFG Fisheries Restoration Grant Program. PWA proposed to conduct sediment source investigations and develop prioritized erosion control and erosion prevention plans for the Signal and Inman Creek sub-watersheds of the Garcia River basin. The proposal was accepted for funding, and PWA received a CDFG contract to perform the assessment in early 2006.

Between July, 2006 and November, 2007, PWA conducted an evaluation of site and erosional conditions along roads within both the Inman Creek and Signal Creek watersheds. The work was performed under a CDFG grant (Contract #P0430414), as part of the Garcia River Forest Phase 1 Road Erosion Assessment. Approximately 38 mi of road were surveyed within the 8.6 mi² Signal Creek watershed. Specifically, PWA's goals were to:

1) conduct a field assessment of potential and ongoing surface runoff patterns and erosion risk associated with roughly 12 mi of mainline timber haul roads (including Signal Creek, Lower Signal Creek and Gate 46 Roads, and approximately 26 mi of secondary haul roads of varying construction dates, maintenance histories and conditions,

2) develop a long-term, prioritized erosion control plan that includes recommended treatment prescriptions, typical construction drawings and cost estimates for controlling on-going and future erosion both along the surveyed roads, as well as on the adjacent hillslopes. The cost estimate would include all heavy equipment, labor, material and technical oversight costs to implement the recommended long-term erosion control measures, and

3) compile the field data and prepare final reports for submittal to CDFG ( as well as the NCRWQCB to meet TMDL requirements ancillary to CDFG project requirements).

The erosion assessment protocol developed by PWA and approved by CDFG, NCRWQCB, Army Corp of Engineers, and the National Marine Fisheries Service, was employed to identify sites of existing and potential erosion, to develop treatment prescriptions and prepare this report (Part X, CDFG, 2002). All erosion control measures generally conform to guidance provided in the "*Handbook for Forest and Ranch Roads (PWA, 1994),* and were done in accordance with and followed the techniques and guidance described in the *"California Salmonid Stream Habitat Restoration Manual, Chapters 9 and 10 (CDFG, 2002).*

# 5 SITE CONDITIONS

The Signal Creek watershed is located within the Garcia River basin, approximately 13 mi east of the town of Point Arena and 10 mi northeast of the town of Gualala in Mendocino County (Figure 1). Signal Creek Road is the main access route through the assessment area, and is located off Fish Rock Road, which runs between State Highway 1 near Gualala and Highway 128 southeast of Booneville.

Signal Creek Road is a mainline timber haul road that traverses the Signal Creek watershed from its intersection with Fish Rock Road at its eastern end, to the mouth of Signal Creek at its western end (Figure 1). The PWA assessment began on Signal Creek Road at the drainage divide between Signal and Inman Creeks, and continued to the mouth of Signal Creek, roughly 0.5 mi from its intersection with Graphite Road (Map 1). PWA staff then inventoried a short section of Headwaters Signal Creek Road, and moved on to assess Lower Signal Creek Road from its upper terminus to its intersection with Signal Creek Road at the mainstem of Signal Creek. Lower Signal Creek Road lies in close proximity to the Class 1 East Fork and mainstem of Signal Creek (Map 1). The assessment then continued onto Gate 46 Road, in the southwestern part of the watershed, and the remaining secondary haul roads throughout the watershed.

Except for Signal Creek, Headwaters Signal Creek, Lower Signal Creek, Gate 46 and Old Mill Roads, virtually all of the remaining roads in the watershed have been abandoned for various lengths of time. Many of the ridge roads can be driven or traversed via ATV, while most of the midslope and lower slope roads in the watershed can only be accessed on foot. Dense whitethorn and manzanita, young Douglas fir and redwood saplings, as well as “washed out or eroded” and decommissioned or partially excavated stream crossings prevent vehicle access. Some of these roads will need to be re-opened with heavy equipment before erosion control work can proceed.

The Signal Creek assessment area contains densely forested hillslopes dominated by Douglas fir, redwood, tan oak, madrone and true oaks, with a dense understory of shrubs. The assessment area has been repeatedly logged since the late 1940s. The intense tractor logging through the 1980s has greatly altered the natural surface hydrology of the watershed. Throughout the 1990s, cable yarding was used more extensively, and large areas of the East Fork Signal Creek watershed were clearcut. A 600-acre wildfire occurred within the middle portions of the East Fork in the mid 1990s, resulting in new road construction (i.e., Signal Creek Road) to access the fire area for extensive salvage logging (Map 1). Many springs and streams intersect the roads, and many have been disturbed and filled with sidecast material, slash and debris.

The terrain ranges in steepness from 30% to over 80%. The hillslopes and the roads in the assessed area are underlain by mixed Franciscan Complex rocks, mostly consisting of sedimentary rock types and primarily overlain by soils of the Ornbaun-Zeni Complex. These soils are generally formed from weathered sandstone and shale and have a low clay content in most locations.

Most of the driveable roads in the watershed are native-surfaced, and are relatively stable with generally good driving surfaces. Most road routes have grades between 3% and 16%, but there are a few road reaches that exceed 20% in gradient. All roads are generally flat in cross-section, with periodic undulations that change the surface drainage runoff direction of the road. Several road segments show signs of surface flow, such as slight rilling, but minor road shaping will greatly improve surface drainage and stability.

# 6 ASSESSMENT RESULTS

## 6.1 Road Construction History and Transportation Planning

Prior to conducting the field assessment, an analysis of stereo aerial photographs from 1965, 1988, 1995 and 2004 was performed to determine the locations and extent of roads in the Signal Creek watershed. PWA identified a total of 49.74 mi of "potential road" that has been constructed in the Signal Creek watershed since the 1940s(Table 1, Map 1). As a result of the field assessment, 12.1 mi of these were determined to be prominent skid trails or completely "washed out" streamside roads. Most were barely visible due to dense vegetation (Table 1). Consequently, PWA conducted the field assessment on a total of 37.6 mi of roads in Signal Creek. Of this total, 24.2 mi of road (64% of the total mileage) had been constructed by 1965, 2.4 mi (6%) was constructed between 1965 and 1988, 10.0 mi (nearly 27%) was constructed between 1988 and 1995, and an additional 1.0 mile (nearly 3%) was constructed between 1988 and 2004 (Table 1, Map 1).

At the present time, only 18.3 mi (about 49% of the total) of the Signal Creek road network are driveable by vehicles (Table 1, Map 2). An additional 2.5 mi (about 7%) are abandoned roads that can be traversed by quad, and 16.8 mi (about 45%) are abandoned, overgrown roads that must be walked to observe road conditions (Table 1).

Working closely with TCF Forester Scott Kelly, and following TCF Draft Road Management Policies (Unpublished TCF, May 2007), a preliminary transportation plan was developed for the Signal Creek watershed. The analysis indicated that inner gorge roads in the East Fork and Middle Fork of Signal Creek, as well as in the Signal Creek Spur and Quarry Spur Complexes were not suitable for long-term property management, and were consequently good candidates for road decommissioning (Map 2). As the field assessment proceeded, these routes were recommended for road decommissioning with the understanding that future, new road locations and construction techniques will be required to access the adjacent hillslopes. Table 1 and Map 2 identify sites and adjacent road reaches designated either for upgrade or decommissioning according to the year of road construction and current road accessibility.

**Table 1.** Road construction history, current accessibility and treatment recommendations for roads in the Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Airphoto year | Treatment category | Current Accessibility | | | Total mileage surveyed | Roads not present (mi)[1] | Totals |
|---|---|---|---|---|---|---|---|
| | | Drive | Quad | Walk | | | |
| 1965 | Upgrade | 7.73 | 0.27 | 3.36 | 11.36 | -- | 11.36 |
| | Decommission | 3.04 | -- | 3.64 | 6.68 | -- | 6.68 |
| | No treatment | 1.16 | 0.72 | 4.27 | 6.15 | 7.01 | 13.16 |
| 1988 | Upgrade | -- | -- | -- | -- | -- | -- |
| | Decommission | -- | -- | -- | -- | -- | -- |
| | No treatment | 0.57 | 0.65 | 1.19 | 2.41 | 2.27 | 4.68 |
| 1995 | Upgrade | 4.21 | -- | -- | 4.21 | -- | 4.21 |
| | Decommission | -- | -- | 0.77 | 0.77 | -- | 0.77 |
| | No treatment | 1.59 | 0.90 | 2.53 | 5.02 | 2.74 | 7.76 |
| 2004 | Upgrade | -- | -- | -- | -- | -- | -- |
| | Decommission | -- | -- | 0.59 | 0.59 | -- | 0.59 |
| | No treatment | -- | -- | 0.44 | 0.44 | 0.09 | 0.53 |
| **Total** | **--** | **18.3** | **2.54** | **16.79** | **37.63** | **12.11** | **49.74** |

[1] Roads thought to be haul roads during air photo analysis that were actually deemed to be large skid trails during field assessment.

## 6.2 Sediment Source Assessment

We inventoried a total of 109 stream crossings in the Signal Creek watershed assessment area (Table 2, Map 3), and 92 of these have been recommended for treatment (Map 4, Appendix A). Nearly 12,300 $yd^3$ of future sediment delivery can be saved over several decades by completing the suggested road upgrading or decommissioning at these stream crossings (Table 3).

Table 4 provides a breakdown of stream crossing sites by the type of stream crossing drainage structure present and includes data summarizing estimated future sediment delivery volume, erosion potential and diversion potential. Stream crossings in the Signal Creek watershed can be divided into 6 types. They are:

**Table 2.** Inventory results and treatment recommendations for sediment delivery sites and hydrologically connected road segments, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Type of sediment delivery site | Sediment delivery sites | | Hydrologically connected roads | | Total roads surveyed (mi) |
|---|---|---|---|---|---|
| | Inventoried (#) | Recommended for treatment (#) | Inventoried (mi) | Recommended for treatment (mi) | |
| Stream crossing | 109 | 92 | 10.5 | 9.7 | - |
| Landslide | 5 | 3 | 0.3 | 0.2 | - |
| Other[a] | 18 | 16 | 1.6 | 1.6 | - |
| **Total** | **132** | **111** | **12.4** | **11.5** | **37.9** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.

**Table 3.** Estimated future sediment delivery for sites and road surfaces recommended for treatment, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Sources of sediment delivery | Estimated future sediment delivery ($yd^3$) | Percent of total |
|---|---|---|
| Stream crossings | 12,270 | 48% |
| Landslides | 3,525 | 14% |
| Other sites[a] | 200 | 1% |
| Hydrologically connected road and cutbank surfaces adjacent to sediment delivery sites[b] | 9,280 | 37% |
| **Total** | **25,275** | **100%** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.
[b]Decadal sediment delivery for unsurfaced roads, assuming a 25 ft wide road surface and cutbank contributing area, and 0.2 ft lowering of road and cutbank surfaces per decade on drive roads, and 0.1 ft on all other roads.

(1) Decommissioned crossings: partially or completely excavated stream crossings.
(2) Fill crossings: earthen fill crossings generally located at small ephemeral streams where no drainage structure was installed to convey stream flow across the road.
(3) Culvert crossings: stream crossings with some type of pipe to convey flow.
(4) Bridge crossings.

(5) Humboldt crossings: stream crossings consisting of varying amounts of large wood and logs placed in the stream channel and then buried with fill to accommodate vehicular passage.
(6) Armored fill crossings: similar to fill crossings, but where there has been an effort to armor the fill slopes and road bed with coarse riprap to prevent erosion of the underlying fill material, instead of using a culvert.

Most of the 52 stream crossing culverts in the assessment area are undersized for the projected 100-year storm flow, too short to effectively convey streamflow through the road fill (resulting in outlet erosion), and installed high in the fill with very flat gradients. The sharp decrease in the stream channel gradient associated with shallow culvert installations causes the stream channel to lose its transport capacity for sediment and organic debris, and thus increases the plugging potential of the culvert. Future sediment delivery from the culverted stream crossings is estimated to be over 7,750 $yd^3$ , or 63% of the total estimated future stream crossing sediment production (Table 4).

**Table 4.** Inventoried stream crossings by type, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Stream crossing type | Inventoried (#) | Recommended for treatment (#) | Stream crossings recommended for treatment | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Future sediment delivery[1] ($yd^3$) | Erosion potential (#) | | | Diversion potential (#) | Currently diverted (#) |
| | | | | H/ HM | M/ ML | L | | |
| Decom-missioned | 28 | 18 | 1,175 | 1 | 12 | 5 | 6 | 1 |
| Fill | 21 | 18 | 3,010 | 4 | 10 | 4 | 11 | 6 |
| Culvert | 52 | 50 | 7,755 | 6 | 28 | 16 | 31 | 0 |
| Bridge | 3 | 3 | 65 | 1 | 1 | 1 | 1 | 0 |
| Humboldt | 2 | 1 | 270 | 1 | 0 | 0 | 0 | 0 |
| Armored fill | 3 | 2 | 0 | 0 | 0 | 2 | 0 | 0 |
| Total | **109** | **92** | **12,275** | **13** | **51** | **28** | **49** | **7** |

[1]Future sediment delivery does not include persistent surface erosion along hydrologically connected roads.

The road fills at 28 stream crossings along abandoned or decommissioned roads in the Signal Creek watershed have been at least partially excavated and removed (Table 4). Under the previous ownership, road fill material was excavated at 18 stream crossings to a depth sufficient to pull out existing culverts, but some amount of the fill underlying the culvert was left in the

stream crossing. At many of these partially excavated stream crossings, PWA field personnel observed channel incision through the remaining road fill. This has created the potential for future sediment delivery and created a stream channel through the remaining road fill with steep, unstable banks that are failing or have the potential to fail into the streams. Future sediment delivery from the partially decommissioned stream crossings is estimated to be approximately 1,175 $yd^3$ , or nearly 10% of the total stream crossing sediment production (Table 4). At the 10 remaining decommissioned stream crossings, virtually all the road fill was properly excavated, and minimal post-excavation channel adjustments have occurred.

The assessment identified 21 earthen fill stream crossings with no apparent drainage structures to convey streamflow through the road prism. These fill crossings are generally constructed across small, ephemeral class III streams that only flow in response to heavier rainfall. Future sediment delivery from earthen fill stream crossings, assuming they eventually wash out, is estimated to be approximately 3,010 $yd^3$ , or nearly 25% of the total stream crossing sediment production (Table 4).

Thirty (30) of the inventoried stream crossing culverts (58% of the total) in the assessment area are classified as having a high to moderate plug potential rating. A total of 49 stream crossings have the potential to divert streamflow down the road and potentially cause significant gully erosion along the road bed and on the adjacent hillslopes (Table 4), and of these, 7 streams are currently diverted out of their natural channels (Table 4). Many of these are located where the roads intersect small ephemeral streams, and many are resulting in ongoing gully erosion and sediment delivery to adjacent stream channels.

Of the existing or potential future landslide sites observed in the field, only those sites with a potential for sediment delivery to a stream channel were inventoried. A total of 5 landslides or potential fill failures were identified during the assessment. Of these, 3 were recommended for treatment. Potential fillslope landslides are expected to deliver approximately 3,525 $yd^3$ of sediment to Signal Creek and its tributaries in the future (Table 3). Three (3) of the potential landslide sites were found along roads where material had been sidecast during earlier road construction and now shows signs of instability (Sites #557, #603 and #618; Map 3).

At Site #545 (Map 3), Lower Signal Creek Road crosses a large, actively failing, deep-seated rotational landslide. Maintaining long-term vehicular access at this location will be very problematic and expensive, and consequently the site and road have been recommended for decommissioning. Site #545 accounts for an estimated 3,300 $yd^3$ (nearly 94%) of the total predicted future sediment delivery volume for landslide sites. At Site #631, the abandoned and overgrown road crosses another slow moving, deep-seated landslide. No treatments have been recommended at this site.

A total of 18 sites are listed in the “other” section of Table 2. These include 6 gullies resulting from uncontrolled road drainage, 4 ditch relief culvert sites, 4 road surface erosion sites, 2 spring

sites, 1 site of ditch erosion, and 1 landing fill site. PWA has recommended treatment at all but 1 of these sites (a gully). We estimate that these sites together will generate approximately 200 $yd^3$ of future sediment delivery if they are not treated (Table 3).

Currently, a total of 12.4 mi of road (33% of the total surveyed road length) is hydrologically connected and delivers road bed-derived runoff and sediment to streams (Table 2). Of this, we have recommended road drainage treatments for 11.5 mi. Applying a road surface lowering rate of 0.2 feet/decade to the length of hydrologically connected road on Signal Creek Road, Headwaters Signal Creek Road, Lower Signal Creek Road, and Gate 46 Road, and 0.1 feet/decade on all other secondary roads (which have much less activity), we estimate that the roads will deliver approximately 9,280 $yd^3$ of sediment to nearby streams over the next decade if road surface drainage is not improved (Table 3). This chronic sediment delivery will occur annually through a combination of 1) cutbank erosion delivering sediment to the ditch (triggered by dry ravel, rainfall, freeze-thaw processes, cutbank slides and brushing practices), 2) inboard ditch erosion and sediment transport, 3) mechanically pulverizing and wearing down the road surface during dry periods due to vehicular use, and 4) erosion of the road surface during wet weather periods, when virtually every vehicle pass entrains sediment that can be transported to inboard ditches and gullies, and thence to nearby streams.

In summary, improving the road drainage design and treating potential erosion sites as proposed could prevent a total of over 25,270 $yd^3$ of future sediment delivery to streams over several decades (Table 3), as well as lessen future road maintenance requirements along the affected roads.

## 7 TREATMENT PRIORITY

This erosion assessment is intended to provide information to guide long-range transportation planning, as well as identify and prioritize erosion prevention and erosion control activities along the assessed roads within the Signal Creek watershed. As a result, not all of the sites that have been recommended for treatment have the same priority. Treatment priorities are evaluated on the basis of several factors and conditions associated with each potential erosion site.

These include:

(1) the expected volume of sediment to be delivered to a stream;

(2) the potential for future erosion (high, moderate, low);

(3) the urgency of treating the site (treatment immediacy);

(4) the ease and cost of accessing the site for treatment; and

(5) the logistics and costs of recommended treatments.

Sediment delivery sites have been classified by number, type, treatment immediacy, and the total future erosion volume attributed to each treatment immediacy group (Table 5). The location of each site, according to treatment immediacy, is shown on Map 4.

## 8 EROSION CONTROL PLAN

The general types of recommended corrective measures along the assessed roads in Signal Creek are displayed in Table 6. Individual data forms for each of the 132 mapped sites of potential sediment delivery have been compiled in a Microsoft Access database. The detailed treatments at each site are described on the data forms and in the database. Appendix A provides a summary of site conditions and treatment recommendations at each site. Typical construction diagrams for each type of treatment category are shown in Appendix B.

The installation of new culverts has been recommended at 14 locations where no culvert is currently installed (Table 6). The replacement of 19 undersized and deteriorating stream crossing culverts is recommended to upgrade the sites to accommodate the 100-year discharge and eliminate ongoing and potential future erosion. A total of 36 critical rolling dips have been recommended to prevent future diversions at stream crossings that currently have a diversion potential. Two flatcar bridges should be installed along Gate 46 Road at large crossings on the West Fork of Signal Creek (Maps 3 and 4). As part of decommissioning Lower Signal Creek Road, the existing bridge at Site #556 will be removed and reinstalled at a West Fork crossing, and consequently only one flatcar bridge will need to be purchased. This plan calls for decommissioning 22 stream crossings by completely excavating all road fill material and re-establishing the original, natural stream channel gradient and side slope configuration through each crossing.

Six (6) armored fills crossings have been prescribed, requiring 145 $yd^3$ of clean, mixed-size riprap (Table 6). Downspouts have been recommended to protect the fillslope below 4 stream crossing culverts and 4 ditch relief culverts. Trash racks will be installed to lower the risk of culvert plugging at 6 stream crossings. In addition, a total of 550 $yd^3$ of mixed diameter and clean riprap-sized rock will be required for the armoring of 24 stream crossing fill faces.

Correcting or preventing potential landslides associated with road fill failures is relatively straightforward. Stabilization efforts usually involve the physical excavation of potentially unstable road fill and sidecast materials and/or the application of road drainage treatments to prevent road runoff from draining onto the unstable area. We have recommended this treatment at 2 potential road fill failure sites, excavating a total of 380 $yd^3$, and stockpiling the excavated material in stable locations.

**Table 5.** Treatment immediacy ratings for all sites recommended for erosion treatment in the Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Treatment immediacy | Number of upgrade Sites | Number of decommission sites | Number of treatment sites by type[a] | Estimated future sediment delivery[b] ($yd^3$) | Percent of total |
|---|---|---|---|---|---|
| High | 2 (578, 590) | 2 (545, 551) | 3 stream crossings, 1 landslide | 4,299 | 17% |
| High-moderate | 5 (520, 534, 541, 581, 593) | 3 (555, 564, 591) | 8 stream crossings | 3,265 | 13% |
| **Subtotal for high + high-moderate: 7,564** | | | | | **30%** |
| Moderate | 25 (501, 502, 503, 508, 509, 522, 524, 525, 532, 535, 537, 538, 573, 574, 575, 582, 583, 584, 585, 586, 592, 604, 609, 610, 613) | 13 (542, 546, 549, 550, 553, 554, 556, 558, 566, 601, 618, 620, 627) | 30 stream crossings, 1 landslide, 7 other | 9,359 | 37% |
| Moderate-low | 26 (500, 505, 506, 507, 510, 511, 512, 514, 516, 526, 528, 529, 530, 531, 536, 539, 540, 570, 576, 577, 587, 602, 603, 607, 608, 612) | 9 (547, 548, 552, 561, 621, 622, 623, 628, 630) | 30 stream crossings, 1 landslide, 4 other | 5,376 | 21% |
| **Subtotal for moderate + moderate-low: 14,735** | | | | | **58%** |
| Low | 19 (504, 513, 515, 517, 518, 519, 523, 527, 568, 571, 572, 579, 580, 588, 605, 611, 614, 615, 616) | 7 (559, 560, 562, 563, 565, 617, 619) | 21 stream crossings, 5 other | 2,979 | 12% |
| **Total** | **79** | **32** | **92 stream crossings, 3 landslides, 16 other** | **25,279** | **100%** |

[a]*Other* sites include ditch relief culverts, point source springs, roadside gullies, and miscellaneous discharge points for road surface drainage.
[b]*Estimated future sediment delivery* includes sediment delivered from treatment sites and any adjacent hydrologically connected road reaches.

**Table 6.** Recommended treatments for all inventoried sites and road surfaces, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Treatment type | | No. | Comments |
|---|---|---|---|
| **Site specific treatments** | Culvert (install) | 14 | Install a culvert at an unculverted fill. |
| | Culvert (replace) | 19 | Replace an undersized or damaged culvert. |
| | Critical dip | 35 | Install to prevent stream diversions. |
| | Bridge (install) | 2 | Install a bridge at stream crossings (site #590, #602). |
| | Wet crossing | 6 | Install 6 armored fill crossings using 145 $yd^3$ of riprap and rock armor. |
| | Decommission stream crossing | 22 | Decommission stream crossings by excavating all road fill material. |
| | Downspout | 4 | Install to prevent erosion at culvert outlets. |
| | Trash rack | 6 | Install at culvert inlets to prevent plugging**.** |
| | Rock (armor) | 24 | At 24 sites, add a total of 550 $yd^3$ of rock armor on inboard and outboard stream crossing fillslopes. |
| | Soil excavation | 58 | At 58 sites, excavate and remove a total of 17,574 $yd^3$ of road fill, primarily from landslides and stream crossings. |
| | Miscellaneous treatments | 13 | Miscellaneous treatments at 15 site specific locations (e.g. cleaning plugged culverts, installing flared culvert inlets, excavating local soil for rebuilding fillslopes). |
| **Road drainage treatments** | Berm (remove) | 13 | At 13 locations, remove a total of 2,278 ft of berm to improve road surface drainage. |
| | Outslope road and remove ditch | 32 | At 32 locations, outslope road and remove ditch for a total of 16,228 ft of road to upgrade and improve road surface drainage. |
| | Outslope road and retain ditch | 3 | At 3 locations, outslope road and retain ditch for a total of 680 ft of road to improve road surface drainage. |
| | Outslope to trail | NA | Decommission outslope with a 10% outslope gradient for 11,315 ft, leaving a level path wide enough for quad and foot traffic. |
| | Ditch (clean or cut) | 2 | At 2 locations, clean or cut ditch for a total of 310 ft. |
| | Ditch relief culvert (install or replace) | 13 | Install or replace ditch relief culverts to improve road surface drainage. |
| | Ditch relief culvert downspout | 4 | Install to prevent erosion at DRC outlets. |
| | Rolling dip | 232 | Install to improve road drainage. |
| | Cross road drain | 305 | Install on decommissioned roads to improve drainage. |
| | Road rock (for road surfaces) | 20 | At 20 locations, use a total of 480 $yd^3$ of road rock to surface the road at 2 stream culvert installations, 14 rolling dips, 900 ft of outslope and remove ditch, 200 ft of outslope and retain ditch, and 2 other site-specific locations. |

We have prescribed converting insloped, flat or crowned road shapes to 3%-4% outsloped road shapes with no inboard ditches to better disperse road surface runoff along 32 road segments totaling 16,230 ft in length (Table 6). Outsloping the road while retaining the inboard ditch to convey emergent cutbank flow to a drainage structure is prescribed for 3 road segments totaling 680 ft. Over 11,000 ft of Lower Signal Creek Road that does not meet TCF long-term forest management needs will be decommissioned by outsloping with a 10% cross road gradient. The decommissioned road will be converted to a foot/quad trail. The cleaning or cutting of the inboard ditch is prescribed at 2 locations totaling 310 ft of ditch. Finally, at 13 locations totaling 2,280 ft, we have recommended retrieving or pulling the berm along the outside edge of the road to improve the dispersion of concentrated road runoff.

We have recommended the installation or replacement of a total of 13 ditch relief culverts to disconnect inboard ditches from stream crossings and hillslope gullies (Table 6). Also recommended is the construction of 232 rolling dips at selected locations at spacings dictated by the steepness of the road. On roads to be decommissioned, 305 cross-road drains have been prescribed to ensure maintenance-free drainage. Once the road shaping and road drainage structures have been constructed, sections of the road that were previously rocked should be re-rocked with 1.5-inch diameter, relatively clean rock to a depth of 3" to 4". Approximately 480 $yd^3$ of road rock will be required to surface upgraded road at 20 locations.

## 9 EQUIPMENT NEEDS

Equipment needs for work at all sites with future sediment delivery are detailed in the project database and summarized in Table 7 as equipment times, in hours, to treat all sites and hydrologically connected road reaches identified in the assessment.

Recommended treatments for the 111 sites in the Signal Creek watershed assessment area will require approximately 800 hr of excavator time and 1,200 hr of bulldozer time for completion of all prescribed upgrading, decommissioning, erosion control and erosion prevention work (Table 7). Excavator and dozer work is not needed at all the sites that have been recommended for treatment, and likewise, not all the sites will require both a dozer and an excavator.

Approximately 160 hr of water truck time will be needed for application of water to dry soils during road drainage treatment implementation and for backfilling of stream crossing and ditch relief culvert excavations. Water will be drafted from Signal Creek at Site #573 and/or from the class II tributary adjacent to Gate 46 Road, and a 1600-series water drafting permit will be obtained from CDFG prior to the start of operations. A total of 40 hr of loader time will be required for moving and loading fill material at stream crossing decommissioning sites. For the transportation of spoil material between sites, 230 hr of dump truck time will be required. A total of 270 hr of labor time are needed for a variety of tasks such as installation or replacement of

culverts, downspouts, trash racks, etc. (Table 7). The equipment and labor estimates in Table 7 include only the time needed to treat each of the sites, and do not include travel time between work sites, the time needed for work conferences, or for applying secondary erosion control measures (seed, straw etc.). These additional times are accumulated as "logistics" and have been added to the work times to determine total equipment costs as shown in Table 8.

**Table 7.** Estimated heavy equipment and labor requirements for treatment sites based on treatment immediacy, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Treatment immediacy | # of sites | Excavated volume[a] ($yd^3$) | Excavator (hr) | Dozer (hr) | Loader (hr) | Dump truck (hr) | Water truck (hr) | Labor (hr) |
|---|---|---|---|---|---|---|---|---|
| High or high-moderate | 12 | 11,989 | 283 | 300 | 0 | 111 | 30 | 57 |
| Moderate or moderate-low | 72 | 11,599 | 446 | 734 | 40 | 117 | 104 | 183 |
| Low | 27 | 1,088 | 68 | 161 | 0 | 0 | 28 | 32 |
| **Total** | **111** | **24,676** | **797** | **1,195** | **40** | **228** | **162** | **272** |

*Note*: Equipment and labor times do not include hours necessary for opening roads, traveling between sites, and spreading straw and mulch.

[a]Excavated volume includes material permanently removed and stored as well as material excavated and reused for backfilling upgraded stream crossings.

Table 8 also includes additional equipment and labor times for activities in support of upgrading and decommissioning treatments. These include excavator, loader and dump truck time for distributing culverts and other materials, grader and water truck time for final road shaping and rock application, and additional labor time for tasks such as straw mulch spreading (Table 8).

## 10 COST ESTIMATE

Table 8 summarizes all costs to implement the recommended erosion control treatments along the surveyed roads within the assessment area. The cost estimate is separated into 4 parts: 1) the total heavy equipment and labor costs, including equipment move-in and move-out costs, to treat the 38 mi of road in the Signal Creek watershed assessment area, 2) the costs for materials to complete the project; primarily culverts, rip-rap and road rock, 3) the costs for PWA to provide technical guidance and overall project management of the work, and 4) a determination of the

**Table 8.** Estimated equipment times and costs to implement erosion control and erosion prevention treatments, Signal Creek Watershed, The Conservation Fund Garcia River Forest Assessment, Mendocino County, California.

| Cost category[a] | | Cost rate[b] ($/hr) | Estimated Project Times | | | Total estimated costs[e] ($) |
|---|---|---|---|---|---|---|
| | | | Treatment[c] (hr) | Logistics[d] (hr) | Total (hr) | |
| Move in, move out[f] | Excavator | 100 | 12 | -- | 12 | 1,200 |
| | Bulldozer | 100 | 12 | -- | 12 | 1,200 |
| | Grader | 100 | 12 | -- | 12 | 1,200 |
| | Loader | 100 | 12 | -- | 12 | 1,200 |
| | Water truck | 100 | 12 | -- | 12 | 1,200 |
| Road opening | Excavator | 130 | 25 | -- | 25 | 3,250 |
| | Bulldozer | 95 | 40 | -- | 40 | 3,800 |
| Heavy equipment for site-specific treatments[g] | Excavator | 130 | 758 | 227 | 985 | 128,050 |
| | Bulldozer | 95 | 726 | 218 | 944 | 89,680 |
| | Dump truck | 85 | 240 | 72 | 312 | 26,520 |
| | Loader | 90 | 60 | 18 | 78 | 7,020 |
| | Water truck | 85 | 81 | 24 | 105 | 8,925 |
| | Truck/trailer | 50 | 43 | 13 | 56 | 2,800 |
| Heavy equipment for road drainage treatments[h] | Excavator | 130 | 51 | 15 | 66 | 8,910 |
| | Bulldozer | 95 | 491 | 148 | 639 | 60,705 |
| | Water truck | 85 | 121 | 37 | 158 | 13,430 |
| | Grader | 125 | 40 | 12 | 52 | 6,500 |
| Laborers[i] | | 45 | 382 | 115 | 497 | 22,365 |
| Rock costs (includes trucking for 406 $yd^3$ of road rock and 695 $yd^3$ of riprap) | | | | | | 33,019 |
| Culvert materials costs (520’ of 18”, 1220’ of 24”, 310’ of 30”, 110’ of 36”, 70’ of 42”, 130’ of 48”, 240’ of 54”, and 70’ of 72”, including costs for couplers and elbows) | | | | | | 96,433 |
| Bridge materials (1 flatcar bridge) | | | | | | 25,000 |
| Mulch, seed, and planting materials for 5.9 acres of disturbed ground[j] | | | | | | 3,734 |
| Supervision, coordination, layout, and reporting[k] | | | | | | 109,230 |
| **Total Estimated Costs: $655,369**<br>**Potential sediment savings: 25,275 $yd^3$**<br>**Overall project cost-effectiveness: $25.93 spent per cubic yard of sediment saved** | | | | | | |

**(Continued on next page.)**

**Table 8—continued.**

[a]Costs excluded from the list are for (1) tools and miscellaneous materials, (2) variable administration and contracting expenses, and (3) CEQA and permitting costs.
[b]Heavy equipment costs include operator and fuel. Costs listed are estimates for favorable local private sector equipment rental and labor rates.
[c]Treatment times refer to equipment hours expended explicitly for erosion control and erosion prevention work at all project sites and roads.
[d]Logistics times for heavy equipment (30%) include all equipment hours expended for opening access to sites on maintained and abandoned roads, travel time for equipment to move from site to site, conference times with equipment operators to convey treatment prescriptions and strategies, and an inflation factor. Logistic times for laborers (30%) include estimated daily travel time to project area.
[e]Total estimated project costs for equipment rental and labor are based on private sector rates at prevailing wage. Materials costs are subject to change.
[f]Lowboy hauling costs area based on 2 hauls each (1 to move in and 1 to move out) at 6 hr/trip, for excavator, bulldozer, loader, grader, and water truck.
[g]An additional 12 hours of excavator and dump truck time are added for import of clean fill at upgraded stream crossing sites. An additional 23 hr of truck and trailer time are added for delivering straw to sites. A total of 20 hr of truck and trailer time and 20 hr of loader time are added for delivering culverts.
[h]An additional 23 hours of bulldozer time have been added for decommission outsloping of 11,315 ft of Lower Signal Creek Road, and an additional 40 hr of water truck time and 40 hr of grader time are added for final grading and spreading road rock.
[i]An additional 117 hr of labor time are added for spreading straw mulch and seeding. This includes 23 hr of labor for initial delivery of straw to sites.
[j]Seed costs are based on 35 lb of native seed per acre at $9.75/lb. Straw needs are 50 bales per acre at $6.95/bale.
[k]Supervision time includes detailed layout (flagging, etc) prior to equipment arrival, training of equipment operators, supervision during equipment operations, supervision of labor work, and post-project documentation and reporting.

project cost-effectiveness, calculated by dividing the total estimated project cost by the estimated potential sediment savings. We estimate that a total of approximately $655,369 is needed to complete all the on-the-ground work to storm-proof along 38 mi of timber haul roads in Signal Creek. This equates to an estimated cost-effectiveness of $25.93 per cubic yard of sediment saved within the Signal Creek assessment area.

## 11 CONCLUSION

In May 2007, TCF and PWA submitted a funding request to the CDFG Fisheries Restoration Grant Program to begin the process of implementing site-specific and road drainage treatments along 8.9 mi of roads in the Signal Creek watershed, as outlined in this report. The funding request totaled $372,175, just over one half of the total estimated implementation cost for the entire Signal Creek watershed. to begin implementing erosion control and erosion prevention treatments in the Signal Creek watershed beginning in summer 2008. This request was denied, but TCF is planning on resubmitting the proposal in May 2008.

Implementation of the erosion prevention-and-control treatments outlined in this report and detailed in the erosion assessment data will significantly improve salmonid habitat condition in Signal Creek and its tributaries, and will assist in maintaining the health of the Garcia River, an important salmonid spawning stream.

## 12 REFERENCES

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# Map 1. The Conservation Fund Garcia Forest - Signal Creek Sediment Source Assessment.

## Road Construction History, CDFG Contract # P0430404

Old Mill Road

Signal Ridge Road

Signal Creek Road

Quarry Spur

Hot Springs Road

Signal Creek Spur Complex

Headwaters Signal Creek Road

Gate 46 Road

Middle Fork Complex

Lower Signal Creek Road

Gate 46 Road Spur #4

Fish Rock Road

Gate 46 Road Spur #2

Mendocino County

Point Arena

Boonville

Gualala

### *Road Construction History*

- 1965_roads
- 1988_Roads
- 1995_Roads
- 2004_Roads
- Class I Watercourse
- Class II Watercourse
- Class III Watercourse
- Sediment Delivery Sites
- Class I Watercourse
- Class II Watercourse
- Class III Watercourse
- Signal Creek watershed boundary
- Garcia River Forest boundary

1:18,000

1 inch equals 1,500 feet

0 0.2 0.4 0.6 Miles

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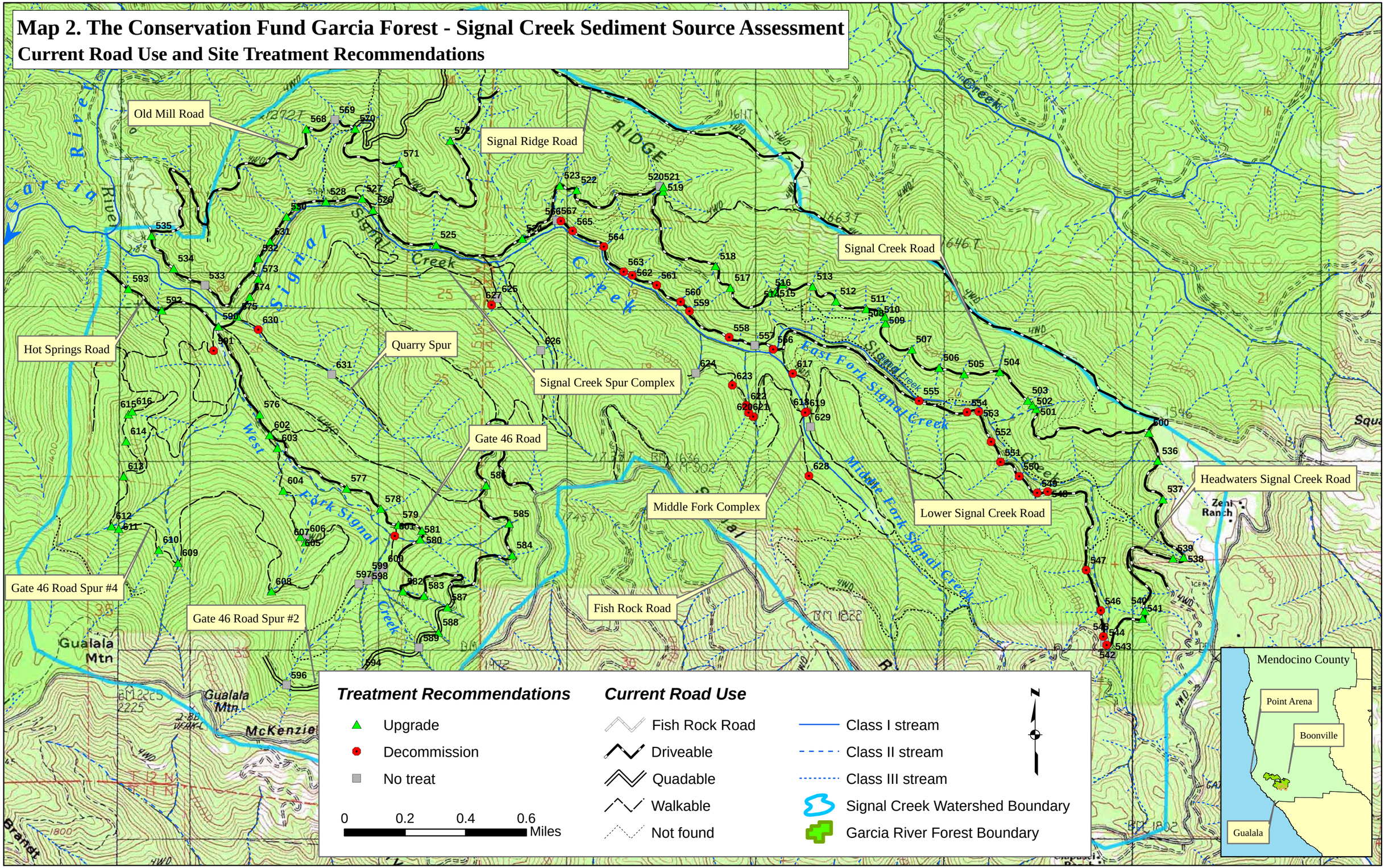
# Map 2. The Conservation Fund Garcia Forest - Signal Creek Sediment Source Assessment

## Current Road Use and Site Treatment Recommendations

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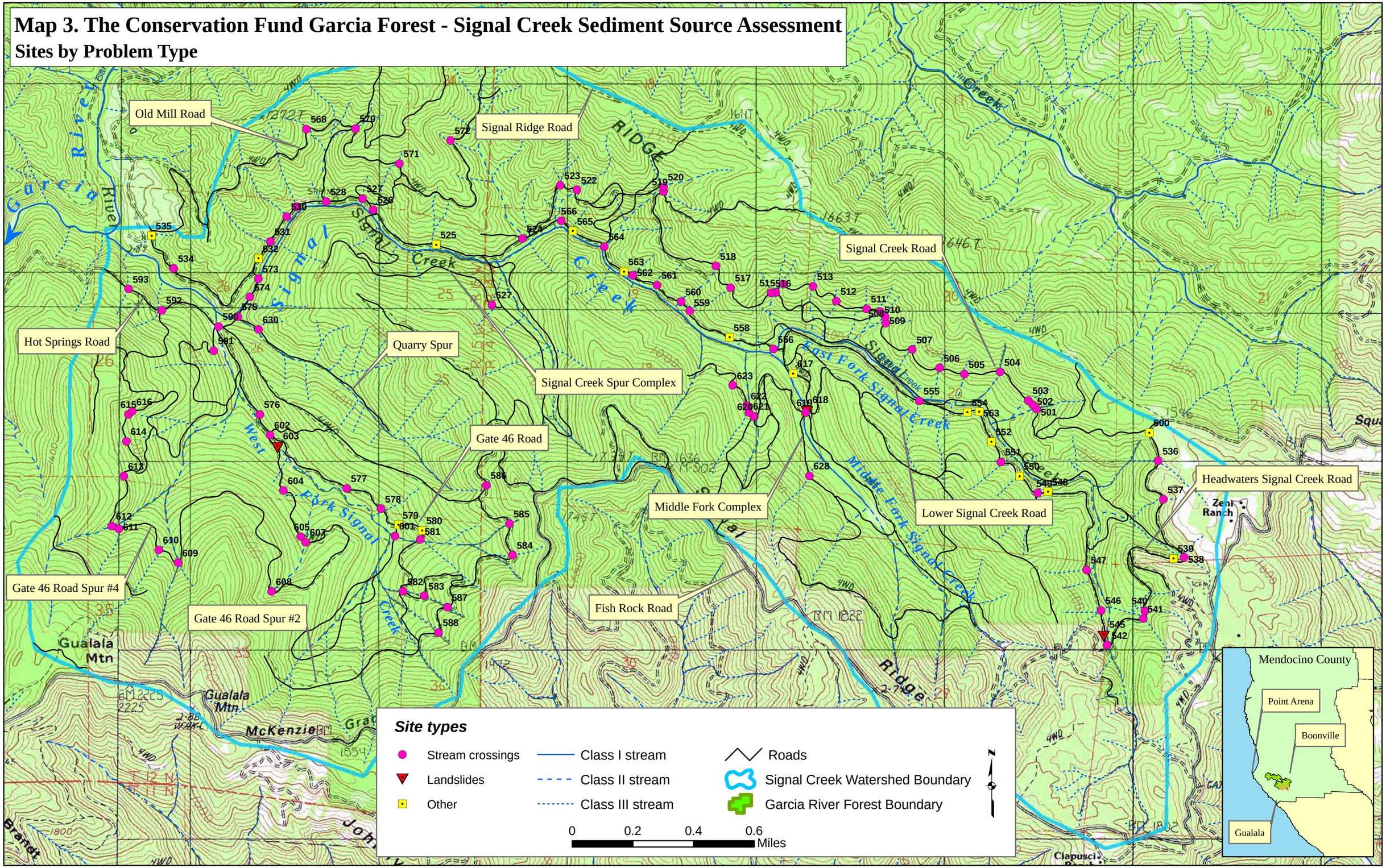
# Map 3. The Conservation Fund Garcia Forest - Signal Creek Sediment Source Assessment

## Sites by Problem Type

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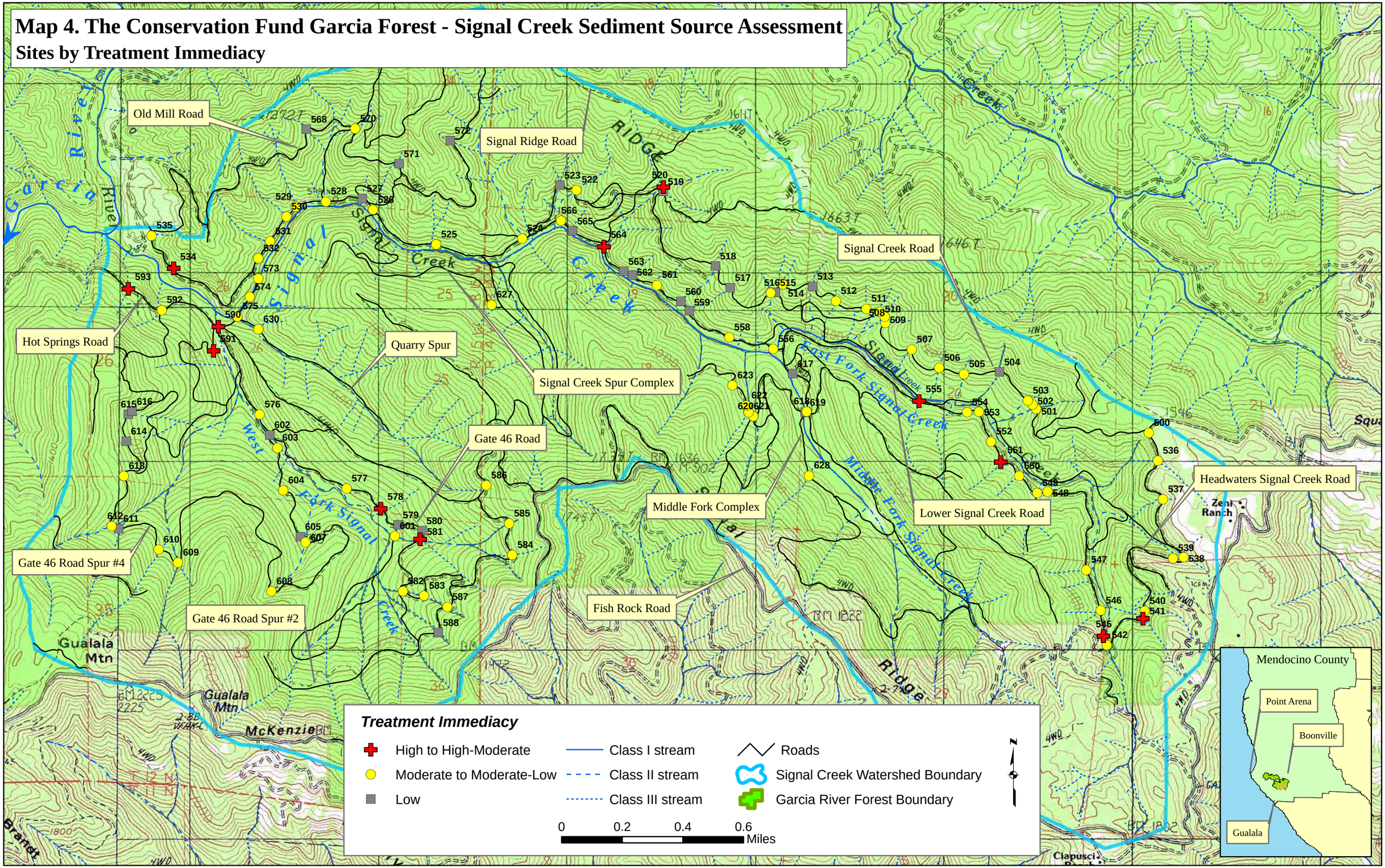
# Map 4. The Conservation Fund Garcia Forest - Signal Creek Sediment Source Assessment

## Sites by Treatment Immediacy

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# Appendix A.

## Summary of Site Conditions

### For Mapped Sites with Potential Sediment Delivery within the Signal Creek watershed, Garcia River Forest Phase 1 Road Erosion Assessment, Mendocino County, California.

# Summary of site conditions - Signal Creek, Garcia Forest Assessment

March 2008

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 500 | Ditch | A 200' long section of through-cut road drains via off-road drain into a class 3 stream. The roadbed is rilled. Flow has gullied down the outboard fill to a stream. The outboard fill is somewhat armored with natural rock. This site is at a "Y" intersection. | ML | 0 | 370 | 0 | ML | 1. Install one rolling dip above the through-cut area.<br>2. Outslope the roadbed and retain the right ditch the length of the through-cut.<br>3. Install 1 30' x 18" ditch relief culvert where flow is exiting the road. ( at the intersection ). |
| 501 | Stream cro | At this site a 30" culvert drains a 4' x 1' class 3 stream. The pipe is well installed. Woody debris in channel above the crossing increases the plug potential. The problem at this site is 1990' of left approach that drains to it. The road reach has no ditch and is mildly outsloped for the entire length. Disconnecting the left approach is the fix for this site. | ML | 1990 | 100 | 40 | M | 1. Install 13 rolling dips up the left approach.<br>2. Add a single post trash rack to the inlet. |
| 502 | Stream cro | This site is a fill crossing. No culvert was observed, but it may be completely buried. Flows cross the roadbed and have developed shallow rills, they have also deposited bedload on the road prism. A 6" flex-pipe protrudes from 6the springy right ditch and outlets just below the outboard road in the channel. A 12" corrugated metal pipe 40" to the right is presently flowing ( Site # 503 ). | M | 0 | 30 | 9 | M | 1. Excavate crossing from TOP to BOT to install a 24" x 40' culvert at channel grade.<br>2. Outslope right road and cut inboard ditch to capture spring flow. |
| 503 | Stream cro | This site is a presently flowing stream. The inlet is 60 % plugged with sediment and leaves. The Pipe appears to have overtopped in the past with only minor rilling across the roadbed. There is heavy spring flow to the left of the crossing from the cutbank. | ML | 0 | 75 | 9 | M | 1. Excavate the crossing from TOP to BOT. Replace the culvert with a 24" x 40' pipe set in at channel grade.<br>2. Outslope the road and fill the ditch for 75' to the left. |
| 504 | Stream cro | This site is a 2' x 1' class 3 stream drained by an armored fill crossing. The crossing is well armored at the outboard fill with 1'-4' rock and functions well. 260' of the left approach and 130' of the right approach deliver to this site. The steep gully down the cutbank to the right should be drained with a ditch relief culvert. | L | 260 | 130 | 0 | L | 1. Add 1 rolling dip to the left approach.<br>2. Install an 18" x 20' ditch relief culvert in the axis of the gully 80' to the right of the crossing.<br>3. OSF-FD 260' of left approach. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 505 | Stream cro | Colluviums and stream sediments have buried the inlet of this culvert. The channel is very steep and rocky above the crossing. The left cutbank is bedrock. The roadbed has standing water. The outlet of the culvert has a trickle of flow coming out. The pipe appears to be well placed in the fill. The outboard fill is well armored enough that if (when) the pipe plugs again, the crossing will act as an armored fill. | M | 520 | 260 | 52 | ML | 1. Clean the inlet with the excavator.<br>2. Install a 12" flared inlet.<br>3. Outslope and remove the ditch along 520' of the left road.<br>4. Install 3 rolling dips up the left road/<br>5. Outslope and remove the ditch along 260' of the right road.<br>6. Install 1 rolling dip to the left. Endhaul spoil. |
| 506 | Stream cro | Similar to site #505. The stream has a bedrock channel above the road. Cutbank colluviums and stream sediments have buried the inlet of the culvert. The entire outboard fill is armored with 2'-3' rock. The crossing is presently acting as an armored fill. There is a burnt stump in the channel just above the road. | ML | 275 | 85 | 104 | ML | 1. Use the excavator to daylight inlet and remove the stump in the channel above the road.<br>2. Install an 18" flared inlet.<br>3. Outslope left and right approaches.<br>4. Install 2 rolling dips up the left approach.<br><br>Endhaul spoil - too large to use on the roadbed. |
| 507 | Stream cro | An 18" corrugated metal pipe drains a steep 2' x 1' class 3 stream. The pipe is plugged due to steep rocky channel and raveling cutbanks overwhelming the inlet. The outboard fill is well armored with 1'-4' rock and functions well as an armored fill. We recommend cleaning the culvert and installing a flared inlet. Both approaches deliver to the site. Spoil can be broadcast on the road. | L | 225 | 290 | 108 | ML | 1. Clean the culvert inlet.<br>2. Install an18" flared inlet.<br>3. Add 1 rolling dip to the right approach and 2 rolling dips to the left approach.<br>4. OSR-FD 225' left and 290' right approaches. |
| 508 | Stream cro | This culvert may be set too high in the fill to capture all stream flow hence the minimal rust line. Large burnt stumps to the right and below the outlet exhibit basal flare. Sediment appear to aggrade for ~ 15' above the inlet but haven't plugged the inlet yet. | L | 650 | 0 | 0 | M | 1. Outslope the road and remove the ditch for 650' up the left approach.<br>2. Install 4 rolling dips up the left approach. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 509 | Stream cro | This site is a 24" culvert that drains a 4' x 1' class 2 stream. The bottom of the pipe is rusted out at the inlet and flows are piping through the fill. A 30 cy lobe of perched material in the channel above the TOP should be removed. Very short approaches deliver little. The outboard fill is well armored with 1'-4' rock that can be re-used. | M | 50 | 40 | 79 | M | 1. Excavate from TOP to BOT. Remove existing pipe and replace with a 30" x 40' corrugated metal pipe in the stream axis at channel grade.<br>2. Re-use 1'-4' rock to rebuild the outboard fill.<br>3. Define the channel above TOP by removing ~ 30 cy of perched material in the channel. Store spoil locally. |
| 510 | Stream cro | There is a skid intersection along the left side of the crossing within the hingeline and then the skid re-crosses the stream above the road. The stream is more swale-like above the road and develops into a class 3 stream below the road. There is very little sign of flow across the road. The outboard fill is rocky. | ML | 230 | 0 | 13 | ML | 1. Remove the skid fill from the stream above the road.<br>2. Install an armored fill at the crossing on the road (see hand out ).<br>3. Install 2 cross road drains on the skid to the right of the crossing.<br>4. Outslope road and remove ditch for 250' along the left approach.<br>5. Install 1 rolling dip up the left approach.<br>6. Rock the road through the crossing. |
| 511 | Stream cro | A steep 3' x 1' class 3 stream is drained by a 24" culvert almost at channel grade. The steep outboard fill is well armored with 1' -3' rock and is stable. The problem here is flows have undercut the brow logs above the inlet. The logs are necessary to maintain road width. We calculate 3 hours of labor to fit 3 cy of .5' - 1' rock around the inlet and backfill the void under the brow logs to effectively treat this crossing. 318' of the left approach and 508' of the right approach deliver to this site. The road is mildly outsloped with no ditch. | L | 318 | 508 | 125 | ML | 1. Armor the inboard fill with 3 cy of.5'-1' rock.<br>2. Add 2 rolling dips to the left approach and 4 rolling dips to the right approach. |
| 512 | Stream cro | This site is a culverted stream crossing on a rocky, springy class 2 stream. The inlet is 40% plugged with sediment and litter. The pipe is installed shallow relative to the channel grade, but the crossing fills appear stabile. A small dip in the roadbed reduces any diversion potential. | L | 70 | 10 | 31 | ML | 1. Clean the culvert inlet with the excavator.<br>2. Improve the critical dip along the right hingeline. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 513 | Stream cro | A 3' diameter log along the right bank above the inlet is holding back a bunch of fill- maybe an old skid. It is hard to tell because the Whitethorn is very thick due to a burn in this area. The entire outboard fillslope and channel below the outlet to the BOT is well armored with 2'-3' rock. There is a 4' diameter brow log placed at the outboard fill with a notch cut in it. The BOT is difficult to determine because of rock armor and density of the Whitethorn precludes any vision of the hillsides coming into the channel. | M | 600 | 800 | 266 | L | 1. Pull back over steepened fill above the inlet along the right bank and stockpile locally (35'x3'x12'= 47 cy.).<br>2. Replace the culvert with a 30" x 70' CMP placed in at base of fill and at channel grade.<br>3. Armor steep outboard fill with 30cy of 1' diameter rip rap.<br>4. install 4 rolling dips to left road.<br>5. OSR-FD 600' left road. |
| 514 | Stream cro | 3x1 class 2 stream is drained by a 24" culvert installed very close to grade. Outboard fill is steep but well armored. There may be some slight diversion potential to the right. Lots of loose organics on hillside that could plug pipe. | M | 90 | 0 | 69 | ML | Install a critical dip along right hingeline.<br>Install a single bar trash rack 2ft up from inlet. |
| 515 | Stream cro | Well sized culvert on small stream. Looks to be a small drainage in between site's 514 &516. Pipe may be high in fill. Area below outlet has some armor. Road is dipped thru crossing. | L | 40 | 200 | 46 | L | 1) Install 5cy of 1ft rock armor below outlet. |
| 516 | Stream cro | This 3'x1' Class 3 stream is drained by a 30" culvert. The pipe is long and set very deeply in the fill. It outlets onto a large boulder. The rocky channel cascades steeply downward. There is diversion potential to the left. If this culvert is sized correctly it will serve. There are sandstone bedrock cutbanks on both sides. There is a lot of organic debris in the channel above the crossing. 105' of the right approach delivers. | ML | 0 | 105 | 168 | ML | 1. Install a critical dip on the left hingeline.<br>2. Install a single post trash rack.<br>3. Construct 1 rolling dip on the right approach. |
| 517 | Stream cro | Properly sized and well placed culvert on a very small stream. Pipe looks to receive very little flow. Entire outboard fill is armored with 1ft rock. Inlet is installed in a hole below natural channel. Brow log along outboard road to the right may be site of old diversion gully. Critical dip present but shallow and not tied into cutbank. | L | 75 | 20 | 189 | L | Improve critical dip |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 518 | Stream cro | 3x1 class 2 stream is drained by a 30" culvert that is short and high in fill. The ground is very rocky and culvert may not have been able to be placed any deeper. Outboard fill is steep and well armored. Right road approach is outsloped. | L | 440 | 475 | 0 | L | 1) Outslope 440ft of left road approach and install 3 Rolling Dips<br>2) Install 3 Rolling Dips up right road. |
| 519 | Stream cro | Skidded stream channel for about 40ft before skid leaves channel and travels up hill. Pipe is high in fill. Stream is incising thru outboard fill down to confluence with stream at site#520. Area looks somewhat stable, but stream is actively incising through skid fill above pipe and into fill below outlet. Minimal waterbar on road is acting as a critical dip. Some armor exists below outlet. Future erosion is crossing fill only. | L | 0 | 75 | 75 | L | 1) Install a critical dip along left hingeline. |
| 520 | Stream cro | A 5'x1.5' Class 2 stream is drained by a rusted 30" culvert with a crushed inlet. Stream flow does not enter the culvert at this time but pipe through the fill and do not reemerge in the channel for 75' downslope at the confluence with the stream from Site#319. There is aggraded sediment above the inlet. The high headwall and a large basin attenuate high flow, but this culvert needs replacement at the base of the fill. There is considerable flow in the stream but it all disappears before entering the culvert. There is lots of local rock available to armor the fillslope. | HM | 20 | 80 | 144 | HM | 1. excavate from TOP to BOT. Install a 48" x 60' CMP at channel grade. |
| 521 | Stream cro | Heavily skidded area and Stream channel. Skid to the right of crossing is relatively open. About 30ft up channel from crossing bedrock is exposed. Which is consistent with cutbank to the right. Another 50ft up channel stream has 5ft high vertical banks where stream has incised thru skid fill. Stream crosses road via a small ditch and travels down well armored outboard fill to confluence with site # 520. | L | 30 | 40 | 0 | | No Treat. |
| 522 | Stream cro | Steep 3x1 class 2 stream with bedrock channel. Pipe set high in fill but well armored. Problem is mostly the excessive left road approach. Shallow critical dip is present | ML | 1964 | 0 | 47 | M | 1) Install a critical dip along right road approach.<br>2) Outslope 1000ft of left road and install 13 Rolling dips. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 523 | Stream cro | Well sized culvert. Culvert set high in fill and is shallow relative to channel grade. Sediments have aggraded above inlet but are not blocking inlet. Area below outlet is well armored. A small water-bar in center of crossing probably wouldn't work as a critical dip. Left road approach has rolling dips that could be improved upon. | ML | 400 | 0 | 40 | L | 1) Install a critical dip along right hinge line.<br>2) Remove bolder from inlet.<br>3) Install 3 rolling dips up left road and Outslope for 400 ft. |
| 524 | Stream cro | An 8'x3' Class 2 stream is drained by a 48" culvert. The woody debris floated above the inlet and erosion at the outboard fill indicate the crossing has been overtopped in the past. There is mild diversion potential to the right. Actually 2 streams coalesce 100' above the crossing, the second being a 3'x1' Class 3. This crossing is on an inner gorge road with Signal Creel 150' below. 1430' of the left approach is mostly outsloped with no ditch but a berm retains flow on the road surface for approximately 1000'. A bend in the deep channel above the crossing inhibits rebuilding the inboard fillslope at 2:1, but there is room on the outboard fillslope. Excavate 40 cy of material from the left bank above the inlet to ease the sharp turn in the channel. | HM | 1430 | 0 | 235 | M | 1. Excavate from TOP to BOT. Install a 72"x70' culvert in in the stream axis at the channel grade.<br>2. Excavate 40 cy of material from the left bank above the inlet to straighten the channel.<br>3. Remove 1000' of berm up the left approach.<br>4. Install 10 rolling dips up the left approach. |
| 525 | Spring | Springy headwall area has collapsed and has plugged 90% of the inlet. Outlet is shoutgunned 5ft. Culvert looks to have over topped. Flow could divert down left road. | ML | 0 | 130 | 15 | M | 1) Dip road thru crossing.<br>2) Clean inlet with excavator.<br>3) Install 5cy of 1-2ft rock below outlet. |
| 526 | Stream cro | This steep skidded stream is in a narrow Redwood valley with a remnant skid along the right hingeline. The channel bottom is very rocky both above and below the crossing. There's a curiously high rustline at the inlet. The outlet is shotgunned 5', resulting plunge pool is rocky. There's diversion potential to the right and it appears to have done so in the past, probably before the 24" culvert was installed. | L | 400 | 0 | 62 | ML | 1. Excavate the crossing from TOP to BOT and install a 36"x50' culvert in the stream axis at channel grade.<br>2. Outslope the left approach and remove the berm where needed.<br>3. Install 2 rolling dips to the left.<br>4. Install a critical dip along the right hingeline. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 527 | Stream cro | Culvert crossing at toe of older hillslope debris slide in the axis of a class ll stream channel. Abandoned road/skid crosses channel about 40ft up form inlet. Some spring flow is coming off of abandoned road. Stream has incised thru toe of slide. May be multiple channels, hard to tell with dense vegetation. Outlet of pipe is shotgunned above 3-4ft diameter. Logs. A 12" metal DRC about 90ft of left road delivers to Signal creek. This DRC is draining springy cutbank and is well armored below outlet. | L | 228 | 30 | 112 | L | 1) Clean around inlet and define channel into inlet with an excavator.<br>2) Install 1 Rolling dip up left road. |
| 528 | Stream cro | This 48" culvert drains a 6'x2' Class 2 stream. The pipe is installed high in the fill but it may be as deep as possible due to the boulder/bedrock channel. The mound built up on the downhill side of the crossing serves as a lightweight critical dip. There is a large through-cut berm on both sides of the crossing. 274' of the left approach delivers to this site. | ML | 274 | 0 | 122 | ML | 1Replace the current pipe with a 54"x60' culvert installed at the base of the fill in the channel axis.<br>2. Construct a critical dip on the right hingeline.<br>3. Add 1 rolling dip to the left approach.<br>4. Remove 60' of berm on the left side of the outboard fill if possible. |
| 529 | Stream cro | Steep bedrock stream channel above road. Stream looks to have diverted in the past, probably before 24" CMP was installed. Difficult to determine where BOT should be. Outlet has a 10ft long 1/2 round downspout that carries to rocks and logs below. Culvert and downspout bottoms are fairly rusty and will need to be replaced in near future. | L | 545 | 0 | 50 | ML | 1)Excavate crossing from TOP to BOT to replace culvert with a 24" by 40' long culvert with a 10ft full round downspout.<br>2) Armor lower 1/4 of outboard fill with 10cy of 1-2ft rock.<br>3) Install a critical dip along right hinge line.<br>4) Install 3 Rolling dips up left road.<br>5) OSR-FD 545' up left road approach. |
| 530 | Stream cro | A 4'x1' Class 2 stream is drained by a 36" culvert The culvert functions well. It appears that this site receives diversion from Site # 529 to the left. There is diversion Potential to the left. | L | 206 | 0 | 215 | ML | 1. Install a critical dip on the right hingeline.<br>2. Add 1 rolling dip to the left approach. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 531 | Stream cro | This is a skidded stream channel. Surface flow is intermittent up the channel. It looks like a 4' wide trench was dug up the channel from the inlet. An old road/skid is upslope from the channel on the right bank. The culvert is short and set high in the fill. Flow from the outlet has incised through fill and large woody debris. The outboard fill looks relatively stable. Two fairly large old diversion gullies down the road left that probably predate this culvert installation. | ML | 0 | 100 | 144 | ML | 1. Install a critical dip along the left hingeline. |
| 532 | Spring | skidded swale above road. Two large stumps in center axis of swale just above cutbank. Inboard ditch is ponded with a 2 ft diameter. Log acting as inboard berm. During storm events flow looks to cross road and travel down abandoned skid for 40ft to were it exits skid and caused a large gully down hillside. | M | 40 | 60 | 21 | M | 1) Install an 18" by 40' long DRC at site. Install outlet above skid intersection, at present rill.<br>2) Install a 10ft long downspout.<br>3) Dip road just to the left of new DRC to prevent flow from getting onto old skid. |
| 533 | Gully | Gully down hillside probably form Road above. Fines deposit on road and then resume as a 1x1x350ft gully down to Signal Creek. Outboard fill has been well armored. | L | 360 | 0 | 4 | | No Treat. |
| 534 | Stream cro | Inlet has been crushed by equipment when trying to clean. Flow from outlet has caused a slump block to occur. Block shows up to 8ft vertical displacement. Block is about 12ft wide at the top and about 35ft long. Slight chance that block is an old skid bed. Future erosion is road fill and slump block. Natural channel looks to be to the right of existing outlet. | HM | 0 | 315 | 216 | HM | 1) Excavate crossing form TOP to BOT to replace culvert. Install new culvert at channel grade with outlet to the right of existing outlet.<br>2) Install a 20ft full round downspout.<br>3) Install a critical dip along left hinge line.<br>4) Armor lower 3/4 of OBF with 30cy of 1-2 ft rock<br>5) Outslope 315ft of right rod and install 2 rolling dips. |
| 535 | Ditch relief | DRC drains large flat area, old mill site. Flow from many sources are gathered by my inboard ditch. Outlet has a 20x10x25 erosion hole below it. This is mainly a done deal. | M | 0 | 300 | 19 | M | Replace existing DRC with a 18" by 40' DRC and add a 20' full round downspout. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 536 | Stream cro | Entire channel above road is fill in with Road/skid fill. Channel is intermittent and braided. Pipe is set high in fill and shallow relative to natural channel grade. Outlet has a 10ft half round downspout. Plunge pool 7ft below downspout is bedrock. Water is seeping out of bedrock under culvert. OBF along left hinge line is near vertical and looks unstable | L | 0 | 545 | 157 | ML | 1) Install a critical dip along left hingeline.<br>2) Pull back over steepened fill along left OBF.<br>3) Outslope 545ft of right road and install 3 Rolling Dips. |
| 537 | Stream cro | Stream originates in swale above road. 18" pipe set flat in the fill. 1/2 round downspout. Diversion gully to the left. Right road approach is mostly outsloped. | ML | 0 | 645 | 214 | M | 1) Excavate crossing from TOP to BOT to replace culvert with a 24" by 70' long culvert, set in at channel grade.<br>2) Install a 20' full round downspout.<br>3) Install a critical dip along left hingeline.<br>4) Armor lower 3/4 of OBF with 45cy of 1-2' rock.<br>5) Install 4 Rolling Dips up right road. |
| 538 | Stream cro | This flowing tributary comes down a bedrock cutbank to a vertical 18" plastic stand pipe with whit PVC pipe coming out of it that is probably adjacent landowners well. Part of the flow goes down the inboard ditch to the site. The stream above the inlet has been skidded. The pipe appears to be installed to the left of the stream axis. The outlet is actively eroding the left bank, though not drastically. | M | 30 | 200 | 96 | M | 1. Replace the culvert with a 36"x60' pipe installed in the stream axis at the base of the fill. |
| 539 | Ditch relief | An 18" ditch relief culvert with a 20'-1/2 round downspout drains 212' of ditch with spring flow. This flow has cut a 3'x4'x80' gully down to a Class 2 stream. The road is outsloped with no berm. Ravel from the cutbank has plugged the inlet 50%. Future erosion is based 25% gully enlargement. | ML | 0 | 212 | 9 | ML | 1. Clean the culvert.<br>2. Install an 18"x20' downspout to the existing ditch relief culvert. |
| 540 | Stream cro | There is a bedrock channel above the inlet. The culvert appears to be installed shallow relative to the channel grade, but bedrock suggests the culvert may not have been able to be set in at grade. The outlet has a 1/2 round downspout. The channel below the outlet is naturally rocky. Coarse material in transport has aggraded at the inlet plugging 40 % of the inlet. | ML | 0 | 125 | 64 | ML | 1. Clean the culvert inlet with an excavator.<br>2. Install a critical dip along the left hinge line. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 541 | Stream cro | A 3'x1' Class 2 stream with additional spring flow is drained by a 24" culvert with a high rust line. The culvert is installed high in the fill and 6'-8' to the left of the stream axis in order to outlet onto a large boulder/bedrock outcrop. The crossing appears to have overtopped, with flow cutting a 6'x5'x35'=39 cy erosion gully through fill probably in the natural channel. 227' down the road to the left there is a 10'x4'x200'=296 cy diversion gully. There is a large spoil pile stashed against the cutbank to the left of the inlet. Large boulders in the fill will reduce the excavation production rate. | HM | 0 | 96 | 223 | HM | 1. Excavate the crossing from TOP to BOT. Install a 24"x70' culvert to the right of the boulder/bedrock outcrop at the base of the fill.<br>2. Install a critical dip on the left hinge line.<br>3. Armor the lower 3/4 of the outboard fill face with 30 cy of 1'-2' rock. |
| 542 | Stream cro | A 10'x2' Class 2 stream is drained by a 60" culvert. The pipe is probably set as low in the fill as possible due to 4'-8' boulders in the channel. There is no flow through the culvert at this time but flow is significant 50' up the channel and do not resume below the crossing. Lots of old 2'-3' saw logs in the channel and a large stump with rootwad is perched 50' above the inlet causing scour and may tumble into the channel. The inlet is well armored with 3'-4' boulders. The right bank of the channel has been skidded. Saw logs at the inlet reduce culvert capacity. There is diversion potential to the left. | M | 0 | 875 | 137 | M | 1. Decommission crossing. Excavate the crossing from TOP to BOT giving the stream an 11' width. Lay back the banks 2:1. Spoil locally on road to give it a decommission outslope.<br>2. Rip road and install 17 cross road drains. |
| 543 | Stream cro | This is a 30% washed out Humboldt crossing. The flow presently (low flow period) is staying within the channel and going under the road fill. At higher levels, flow travels down the right road to just outside the natural hinge line, gullies down the outboard fill through large rocky material, and re-enters the channel. The diversion gully appears relatively stable and mossy. The rocky material is probably decreasing flow velocity. The outboard fill within the center-line of the profile consists of 3'-4' diameter large woody debris and 1 large stump turned completely upside down with an 18" diameter Redwood growing out of it. Two large Redwoods on the left hingeline are leaning into the channel indicating movement of the fill. Buried cut logs exist in the channel and on the banks down to Site#543. This is a check site: see comments in the treatment section.<br>JG 6/6/07 Access to this site is very difficult. It would require clearing ~500' of road with trees to 2', plus area for several thousand cy to excavate. The fill is very rocky, with logs and boulders to 4', so very low excavation rate. Also, the left approach impinges on the channel and has a small diverted stream, so we may want to excavate. Main crossing: ~75' Lx40'w x12'd =1300cy, rounded to 1500. The approach is 120'w x25'L x6'd=700cy. There is probably enough space to spoil on the landing. (120'L x35'x with a 15' cutbank height). Recommend no treat. | M | 400 | 0 | 0 | | See comments on problem. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 544 | Stream cro | A springy inboard ditch is presently flowing to the inlet of the pipe. The stream channel above the inlet is deeply incised but appears relatively stable and appears to have a skid crossing it up channel from this crossing. The stream is presently dry. The outlet of the pipe is naturally armored with large woody debris and rock material from Signal Creek. This pipe may have overtopped in the past is suggested by the old diversion gully in the critical dip 40' to the left. | L | 50 | 60 | | | No Treat |
| 545 | Landslide | A massive hillslope debris slide has removed all but 4' of the road prism in places. Material has plugged the creek, but flow is now cutting through the slide material, logs, stumps, and slash. There are cracks in the road surface and the slide is still active. This area failed in the past, the road was dozed across it and it failed again.<br>JG 6/6/07 This is a relatively natural, deep-seated feature. No matter how much material you remove, more is waiting to move down, and none of it is road related. Recommend no treat. | H | 0 | 0 | 3300 | H | 1. Excavate unstable fill from massive slide. Stockpile 6000 cy in safe location. |
| 546 | Stream cro | Pipe inlet is beveled to capture flow. The stream is presently flowing into the inlet but the outlet is dry. The bottom of the pipe is rusted out. The outlet has a 1/2 round downspout. The area below the outlet appears more gully-like than a stream channel. No other channel found. | ML | 0 | 230 | 49 | M | 1. Decommission crossing. Excavate from TOP to BOT giving channel a 4' width. Lay back banks 2:1. Spoil locally on road.<br>2. Rip 230' right road and install 4 cross road drains. |
| 547 | Stream cro | This tiny 1'x1' Class 3 stream has been diverted beyond the natural channel behind a berm 40' to the left into an 18" ditch relief culvert. This pipe carries very little flow because the stream goes subsurface in the natural channel causing a 2'x2'x2' sinkhole at the inboard road and a void under the road. The channel upstream has been fractured with skids in all directions above the crossing. The material can be used to plug the ditch and the excavator used to define the channel for 30' above the new inlet. There is diversion potential to the left. The long right approach has a berm for the entire length. The swale at the upper end of this reach should be drained with a ditch relief culvert. | L | 0 | 780 | 32 | ML | 1. Decommission stream crossing. Excavate from TOP to BOT give channel a 4' width. Lay back banks from 2:1.<br>Spoil locally on road.<br>2. remove berm for 780' right road.<br>3. Rip road and install 14 cross road drains to right. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 548 | Road surfa | This is a gully down the outboard fill just up the right road from a stream crossing. The 2270' of right road contribution has shallow rolling dips, the majority of which deliver to Signal Creek. The gully is at the outlet of a waterbar. The next dip is 250' up the road and is almost entirely filled with sediment. About 200' up road to the right of the gully is an odd looking ditch relief culvert with a downspout that points to the right- not downslope. This may have been done to keep the flow off of an unstable hillside. The entire road has a significant berm. The berm at the site is about 7' tall and 12' wide on top; it may be an old spoil pile or old road bench. The elbow of the ditch relief culvert appears to be leaking. | M | 0 | 2270 | 5 | ML | 1 Remove berm along 2270' of right road.<br>2. Rip road surface along 2270' right road and install 45 cross road drains. |
| 549 | Stream cro | This 6'x1' class 3 stream is drained by a 24" culvert. The pipe is short and installed high in the fill. Pipe shotguns 10' at the outlet and has cut a large erosion hole in the outboard fill and has triggered a small slide on the left bank below the outlet. The large spoil pile to the left of the inlet prevents diversion somewhat. There is diversion potential to the left. Skid on the hillside above may be diverting some flow. Long steep outboard fillslope will reduce excavation production rate. | M | 0 | 40 | 1119 | M | 1. Decommission stream crossing. Excavate from TOP to BOT giving stream a 7' width. Lay back banks to 2:1.<br>Spoil on road to create a decommission outslope. Use 2 dump trucks to distribute fill to good spoil spots on road. Use loader to load trucks when excavator is too deep in hole. |
| 550 | Road surfa | A well defined swale is drained by an 18" ditch relief culvert with a 40' 1/2 - round downspout. The culvert appears to receive very little flow. There is a defined stream valley above the crossing with no bed/bank morphology. The area is covered with leaf litter. About 60' up the right road is a large that is present from the outboard road, down the outboard fillslope, into the swale axis and down to Signal Creek. Not sure what caused the gully. The right approach and the bedrock cutbank could be the source, or the gully may have been developed by an old stream diversion from Site#549. The geology is non-cohesive sandstone that is highly erosive. The erosion potential is based on gully issues and over steepened fill between the gully and the ditch relief culvert. | M | 0 | 460 | 21 | M | 1. Remove 460' of berm to the right.<br>2. Pull back as much of the over steepened outboard fill as possible (60'x3'x8' = 53 cy) Spoil locally down the left approach to the large turnout.<br>3. Rip road and install 9 cross road drains to right road. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 551 | Stream cro | This is a steep 4'x1' Class 2 stream with a fill crossing. Significant flow goes sub-surface and unable to determine where it re-emerges. The channel below the crossing has been skidded and logged. An 18" culvert installed at the left hingeline on the diagonal outfalls beyond the hingeline and has cut a 15'x10'x180' = 1000 cy gully that carries the high flow from the crossing. There are 2 more gullies in the outboard fill from road contribution and possible diversion from Site#550 that add to the erosion. There are deep rills down the insloped and bermed road surface and landing from the right. There is spoil stored on the right side of the inboard fill. There has been a possible debris torrent down the channel above the crossing. Diversion potential to the left. There is room to move the road in 15' to attain a 2:1 slope on the outboard fillslope. A lot of loose road surface and landing material is in transport down the road and into these gullies.<br>JG 6/6/07 Decommission prescription OK. There may be more than 1000 cy here. | H | 0 | 336 | 463 | H | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 4' channel width. Lay back bank 2:1. Spoil on road to create a decom outslope. Truck spoil to good spoil area. |
| 552 | Ditch relief | This ditch relief culvert is installed on the left hingeline of a swale. The swale has minimal channel morphology. The ditch relief culvert outfalls on top of a stump and shotguns 20'. The culvert appears to outlet into an old diversion gully from the swale. The area looks stable below the outlet. The culvert bottom is rusty. | L | 0 | 450 | | ML | 1. Remove 450' of berm to the right.<br>2. Rip road and install 9 cross road drains to right. |
| 553 | Gully | 503' of the right approach drains to this gully at the outfall of a rolling dip. Flow has cut a 3'x2'x200' = 44 cy down to a Class 1 stream. In the middle of the reach there is an old road fill failure that is associated with some springs in the cutbank. A ditch has been cut to prevent saturation of the old failure and should be retained with a ditch relief culvert installed at the downhill end to convey flow under the road. The road is generally flat with berms that retain considerable material to flow down the road and fill in the dips. High road lowering rates should be calculated on this road. Future erosion is based on 50% gully enlargement due to dips filling in and flow continuing down the road. | M | 0 | 503 | 22 | M | 1. Rip road and install 10 cross road drains to right. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 554 | Gully | A series of skids on abandoned road beds concentrate flow to cut a ditch the road near a turnout. The outlet of the ditch gullies down to Signal Creek. The cutbank appears to also be contributing flow to this ditch. Two past outboard fill failures (one at the site flag, and one above, see sketch) have also occurred due to this concentrated flow. A waterbar at the skid intersection (see sketch) is diverting flow into the lower failure area and has caused rock armor to move down the hill. Flow is actively gullying down the hillslope. | M | 0 | 986 | 29 | M | 1. Install 10 cross-road drains op abandoned road/skids to cut off drainage (see sketch).<br>. Remove 986' of berm from right road.<br>3. Install 10 cross road drains up right roasd and rip surface. |
| 555 | Stream cro | This steep rowdy 4'x1.5' class 2 stream is diverted 70' ton the left via a ditch behind a small berm into an 18" culvert that outfalls outside the left hingeline. The flow goes subsurface in the ditch. There's a 10'x5'x190'=333 cy erosion gully down the hillslope from the outlet of the 18" culvert down to Signal Creek.Several more erosion gullies down the left approach have been partially filled with spoil placed on the outboard fill to the left. Recommend retaining the 18" culvert to drain the spring from the cutbank to the left of the crossing. A berm at the outboard fill routes road contributions from the right down the road beyond the crossing. Diversion potential to the left. Wood in the outboard fill will lower production rate. Move the road in 15' to attain 2:1 fillslope. | H | 0 | 330 | 128 | HM | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 5' channel width. Lay back banks 2:1. Store spoil on road to create a decom outslope.<br>2. Rip road and install 7 cross road drains to right. |
| 556 | Stream cro | This is a flat car bridge with log abutments and a wooden travel surface. Rock armor below the abutments protects the banks from stream scour. The bridge fills do not appear to be constricting the stream. The bottom of the bridge is 5' above the thalweg of the stream. Both the right and the left approaches are actively transporting sediment onto the bridge surface. Moderate immediacy because the stream is a Class1. | L | 350 | 465 | 0 | M | 1. Rip road on both approaches and install 7 cross road drains left and 9 right.<br>2. remove berm for 815' total in both directions. |
| 557 | Landslide | The outboard edge of the road is bermed through the slide area with trees growing on it. The entire hillslope below the trees is bare soil. The area appears to be mostly dry raveling with some rilling down to Signal Creek. Excavating the area would only promote sediment delivery to the stream | HM | 0 | 0 | 124 | | No Treat |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 558 | Gully | Flow from a small swale and 225' of the left approach has cut a 2'x2'x200' = 30 cy gully through sidecast fill down to Signal Creek. A berm retains flow on the road surface down to this gully. Future erosion is based on 100% gully enlargement. | M | 225 | 0 | 30 | M | 1. Rip road and install 4 cross road drains left. |
| 559 | Stream cro | This culvert has a bedrock channel above the inlet. The pipe is set shallow relative to the channel grade, but receives very little flow so it's not an issue. The channel beyond the outlet is well armored and stair-steps down the fillslope to the natural channel. | ML | 500 | 20 | 14 | L | 1. Decommission crossing. Excavate from TOP to BOT giving channel a 4' width. Lay back banks 2:1 and spoil locally.<br>2. Rip road and install 10 cross road drains tol eft. |
| 560 | Stream cro | This 3'x1' Class 3 stream is drained by a 24" culvert that is short and installed at a shallow gradient. The channel below the outlet is well armored and shows no sign of erosion. 544' of the left approach has a berm for most of the length but delivery is very low due to low gradient. | L | 544 | 110 | 61 | L | 1. Decommission crossing. Excavate from TOP to BOT. Give channel a 4' width and lay back banks 2:1. Spoil ~140 LOCALLY ON ROAD TO CREATE A DECOM OUTSLOPE.<br>2. Rip approaches and install 11 cross road drains left and 2 to right. |
| 561 | Stream cro | This channel has been skidded above the road. The road is dipped through the crossing. The flow rills across the roadbed and has incised down through the outboard fill. The channel bed through the road fill appears to have been armored with 6" rock. The outboard fillslopes are over steepened and could be laid back further into the road bed. | ML | 75 | 20 | 18 | ML | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 4' width. Lay back banks 2:1. Spoil 50cy locally.<br>2. Rip approaches and install 1 cross road drain to left. |
| 562 | Stream cro | A small 2'x1' Class 3 stream is drained by a 24" culvert with a 20' 1/2-round downspout. The channel braids above the cutbank but a ditch has been cut to route flow to the inlet. There is mild diversion potential to the right. 637' of the left approach with a small berm delivers to this site. | L | 637 | 0 | 76 | L | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 4' width. Lay back banks 2:1. Spoill 148cy locally. Use spoil to crweate a decom outslope on road.<br>2. Rip approaches and install 13 cross road drain to left. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 563 | Gully | This is a full bench road in an inner gorge setting about 80' upslope from Signal Creek. The entire cutbank is fractured bedrock and is highly erosive with talus cones at the base. Runoff from the hillslope and cutbanks have formed 2 gullies below the road. The road is full bench construction, therefore no road fill, but the cutbank wouldn't be here if the road wasn't built. | HM | 80 | 135 | 30 | L | 1. Rip both approaches and install 1 cross road drain to left and 2 to right. |
| 564 | Stream cro | A 15'x2.5' possibly Class 1 stream is drained by a 60" culvert with a very rusty bottom. This low gradient suggests possible anadromy if not for the 3' drop at the culvert outlet into a 20'x20'x2' pool 50' from Signal Creek. Brow logs on both sides of the culvert are undercut. Mild diversion potential to the right. A 30' wide berm on the left approach hinders removal. The road is outsloped. Critical dip should be installed on top of the crossing due to space constraints. | HM | 373 | 0 | 437 | HM | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 15' width. Lay back banks 2:1. Use dum,p trucks to endhaul spoil to a safe location. 2. Rip right road and install 7 cross road drains to left. |
| 565 | Gully | This is a swale above the road with a gully running down the middle of it. The gully most likely developed by concentrated flow fro a road upslope. The gully looks very stable and probably only flow during large storm events. The gully flow exits the road about 40' to the right of where it enters. The outboard fill is very well vegetated and stable. | L | 411 | 60 | 1 | L | 1. remove berm for 411' left road and install 8 cross road drains. |
| 566 | Stream cro | This 24" culvert drains a 3'x1' Class 2 stream. The pipe is short and installed high in the fill. The flat installation causes the inlet to be 50% plugged with sediment. The bedrock channel may preclude installing the pipe any deeper but this is hard to ascertain due to extremely dense Whitethorn at the outboard fill and down the channel. There is diversion potential to the left. | M | 0 | 30 | 34 | M | 1. Decommission crossing. Excavate from TOP to BOT giving stream a 4' width. Lay back banks 2:1. Spoil 80cy locally. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 567 | Stream cro | This site is a 24" culvert on a bedrock channel. There is bedrock above and below the crossing. The pipe bottom is rusty, but not advanced enough to be replaced, and if the bottom did rust out, the flow would be on bedrock. The right ditch is springy and flowing, but appears stable. There is diversion potential but the critical dip will be at Site#566. | L | 0 | 55 | 4 | | No treat |
| 568 | Stream cro | There is a swale above the road with an old hillslope debris slide deposit in the axis or it could be pushed skid material - regardless, the area appears stable. The roadbed is dipped through the swale. The swale develops into a Class 3 stream below the road. The outboard fill is well armored with .5' rock. The armor is mossed over. | L | 140 | 625 | 0 | L | 1. Outslope the road and fill the ditch for 140' and install 1 rolling dip on the left approach.<br>2. Outslope the road and fill the ditch for 625' to the right and install 4 rolling dips. |
| 569 | Stream cro | This is a tiny 1'x1' Class 3 stream drained by an armored fill crossing. The channel is mossed over; no problem here. The approaches are low gradient, mossed and grassy with rolling dips. | L | 300 | 60 | 8 | | No Treat |
| 570 | Stream cro | The channel is bifurcated on either side of a very old hillslope debris slide deposit. The culvert inlet is installed 6' below the channel bottom as evidenced by a 6' vertical face above the inlet. A 5' diameter cut log sits in the channel above the vertical face. The outboard fill is being supported by rotting logs and appear to be failing in some areas. The culvert outlet is at current channel bottom. | ML | 630 | 100 | 82 | ML | 1. Left road: Outslope and fill ditch for 630', remove 630' of berm and install 4 rolling dips.<br>2. Right road : Outslope and fill the ditch for 180' remove 100' of berm. |
| 571 | Stream cro | This very small 2'x1' Class 3 stream that is just a rill across the road, is drains by an armored fill crossing. Stream flow is oriented to the far right side of the armor on the outboard fill, (see sketch) but there is minimal erosion. The road runoff from the low gradient approaches barely moves the pine needles on the road. | L | 100 | 210 | 41 | L | 1. Place 7 cy of 1'-2' rock on the outboard fillslope.<br>2. Add I rolling dip to the left approach and another to the right. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 572 | Stream cro | This is a Class 3 stream with an armored fill crossing. The area appears very stable. There are no signs of rilling across the roadbed. The stream probably only flows during storm events. | L | 530 | 10 | 0 | L | 1. Outslope the road and fill the ditch for 530' to the left and install 3 rolling dips. |
| 573 | Stream cro | This flatcar bridge spans Signal Creek 50' upstream of an old ford crossing. The steel running surface appears to have had the plank surface peeled off and stored on the outboard side of the right approach. The bridge abutments do not appear to pinch the channel. A rotting 2' diameter brow log is placed on the downstream side of the bridge. The right approach with a wet inboard ditch deliver to the site. | ML | 200 | 446 | 0 | M | 1. Install 1 rolling dip to drain the upper 200' of the right approach.<br>2. Install 2 18"x40' ditch relief culverts to the right approach.<br>3. Outslope the road and keep the ditch on the lower 250' of the right approach.<br>4. Outslope the road and keep the ditch on 200' of the left approach.<br>5. Create 1 rolling dip at the top of the curve on the left approach to drain to the inboard ditch.<br>6. Cut a ditch for 80' to drain behind the berm on the left approach. |
| 574 | Stream cro | This 24" culvert installed to the left of the stream axis causes a jog in the channel resulting in incision beyond the outlet through road fill material. This fill exhibits vertical slopes that are calving and being delivered to Signal Creek. Recommend excavating natural channel alignment. Logs in the fill suggest old Humboldt crossing. A stump and 4 1'-1.5' diameter Redwoods above the road will need to be removed. The approaches are low gradient and outsloped and are of little consequence. | M | 0 | 65 | 119 | M | 1. Excavate TOP to BOT removing stump and Redwood cluster above the road, and install 24"x70' culvert in the new alignment at the base of the fill.<br>2. Install a critical dip on the left hingeline. |
| 575 | Stream cro | A 72" culvert drains to this 7'x3' Class 2 stream. The steep boulder filled channel above the crossing is unlikely to support anadromy. The culvert may be undersized. The problem here is the steep left approach with a 4'x3' inboard ditch with spring flows in the lower segment, and then a large landing and an additional 450' of stream side approach above that. | M | 804 | 374 | 321 | M | 1. Add 2 rolling dips to the right approach.<br>2. Install 2 18"x30' ditch relief culverts (1 above and 1 below the through-cut) on the left approach.<br>3. Construct a broad rolling dip across the landing up the left approach.<br>4. Fit in 3 rolling dips on the left approach above the landing.<br>5. Outslope the road and fill the ditch on the 450' of left approach above the landing. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 576 | Stream cro | This low power 3'x1' Class 3 stream has a skid road up the channel. Flow has cut gullies or caused incision in the channel above the crossing. Mostly a done deal now, but the channel walls are vertical in places. Some bedload is deposited on the road, but the flow cuts a gully through the fill at the outboard road and down to the floodplain of a Class 1 stream. The very low gradient here suggests a well rocked rolling dip would be a cost effective treatment. Aggradation in the dip will be a problem, but it would be more of a problem with a culvert. 816' of steep left approach drains to the site. There is very slight diversion potential to the right. This crossing is at the lower end of new road alignment. Estimated 10 cy of future erosion based on gully enlargement. | ML | 816 | 0 | 10 | ML | 1. Excavate dip by removing 81 cy of material and store spoil locally.<br>2. Install a broad rolling dip using 20 cy of 0.5'-1' rock.<br>3. Construct 5 rolling dips up the left approach.<br>4. Remove the small berm for 816' to the left. |
| 577 | Stream cro | This very small stream has been skidded. There is intermittent morphology above the road. Flow has cut a 4'wx4'dx20'L gully through the fill in the outboard fill. There is a 12'wx3'h berm on both approaches (354' from the left and 160' from the right), but rolling dips will drain the low gradient approaches effectively. | ML | 354 | 160 | 13 | ML | 1. Dip out the road and install an armored fill crossing using 10 cy of .5'-1' rock.<br>2. Install 1 rolling dip on the right approach and 2 rolling dips on the left approach. |
| 578 | Stream cro | A 3'x1' Class 2 stream is drained by a Humboldt crossing comprised of at least 2 4' diameter logs that are placed side by side with flow beneath. A small berm has been pushed up at the inboard road to provide some headwall height. There are 2' diameter Redwoods growing on the outboard fillslope. The exposed portions of the Humboldt logs are becoming punky. 253' of the left approach and 53' of the right approach drain to the site. | H | 253 | 53 | 269 | H | 1. Excavate the crossing from TOP to BOT. Install a 24"x80' culvert in the stream axis at channel grade.<br>2. Install 1 rolling dip to the left approach<br>3. Install 1 18"x20' ditch relief culvert to drain the spring on the left approach.<br>4. Outslope the road and fill the ditch 253' to the left and 53' to the right.<br>5. Install 5 cy of 1' rock to the lower 1/4 of outboard fillslope. |
| 579 | Road surfa | An off-road drain outfalls into a Class 1 stream. 450' of the left approach delivers slightly even though the road has rolling dips. This site needs I more rolling dip 75' above this cross road drain. | L | 450 | 0 | 0 | L | 1. Add 1 rolling dip 75' to the left of this site. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 580 | Ditch relief | A very rusty (but not through), short 18" ditch relief culvert drains 156' of springy ditch and a swale. The gully beyond the outlet is laid back and appears stable. The inboard ditch is deep but well vegetated and stable | L | 156 | 0 | 0 | L | 1. Replace the existing ditch relief culvert with an 18"x 30' culvert. |
| 581 | Stream cro | A large 7'x2' class 2 stream is drained by a 30" culvert. The flow goes subsurface 30' above the inlet and emerges 25' downstream of the outlet. Large 4' diameter logs athwart the channel near the BOT suggest a log bridge long ago. A 3x3x400' inboard ditch creates a sediment fan to the left of the inlet. The lower 340' of this ditch receives spring flow from the cutbank and is too steep for rolling dips, but the upper 7243' lessens in gradient and although there are several dips, there needs to be more. There is room to rebuild the fill faces at 2:1 and plenty of rock is available locally. | H | 1064 | 0 | 815 | HM | 1. Excavate TOP to BOT and install a 54"x110'm culvert in the axis at grade.<br>2. Add critical dip to the right hinge.<br>3. Install 2 18"x40' ditch relief culverts on the lower segment of the left approach.<br>4. Install or enhance 6 rolling dips on the upper section of the left approach.<br>5. End haul 60 cy of spoil 500' up the left approach. |
| 582 | Stream cro | A 4'x1' Class 3 stream is drained by a 24" culvert that is short and installed high in the fill. Some logs in the channel 12' downstream of the outlet retain sediment. There is diversion potential to the right. A small berm at the inboard road and a rolling dip 100' up the left approach routes the flow from the left approach around the bend and down the right approach. Twin 2' diameter Redwoods to the left of the channel inhibit culvert alignment. 776' of left approach has 3 weak rolling dips and needs 2 more (not weak). | M | 776 | 0 | 188 | M | 1. Excavate TOP to BOT. Install 30"x70' culvert in stream axis at channel grade. Armor lower 1/4 of the outboard fill with 1'-2' rock.<br>2. Install a critical dip on the right hingeline.<br>3. Enhance 3 rolling dips and install 2 more rolling dips up the left approach. |
| 583 | Stream cro | A 3'x1' Class 3 stream is drained by a short 24" culvert with the outlet installed 12' to the left of the channel axis. There are 1'-2' logs imbedded in the sidecast material of the outboard fill. A spring in the cutbank to the left dribbles into the inlet. There is perched material in the channel below the crossing that is being retained by logs and will fail over time. There is diversion potential to the left. 2118' of the right approach is outsloped with 5 rolling dips that still delivers. The economical fix here would be to install a 24"x20' extension and then a 30 deg. Elbow and a 20' downspout, but this approach is not optimal. | M | 0 | 2118 | 192 | M | 1. Excavate TOP to BOT. Replace the existing culvert with a 24"x80' culvert at the base of the fill in the stream axis.<br>2. Add a critical dip to the left hingeline.<br>3. Enhance or install 14 rolling dips up the right approach.<br>4. Armor the lower 1/4 of the fillslope with 5 cy of 1' rock. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 584 | Stream cro | A 4' x 1' class 3 stream that has been skidded produces a lot of sediment and gravels that have created a broad fan above the road. Wide road width allows more deposition. The road has been slightly dipped out to prevent diversion to the left, but there is evidence it has happened in the past. Flow has cut a 3'w x 3d' x 65'l gully through steep sidecast fill at OBF. May consider over sizing this culvert due to large bedload of the stream. 746' of the right approach drains to this site. Low excavation rate due to material having to be handled twice. | M | 0 | 746 | 693 | M | 1. Excavate from TOP to BOT. Install 30" x 90' culvert in axis and at grade with stream. Reduce road width to 20'.<br>2. Install a critical dip on left hinge.<br>3. Install 5 rolling dips up left approach.<br>4. Armor steep OBF with 65cy 1'-2' rock. |
| 585 | Stream cro | The channel of this 3'x1' Class 2 stream has been skidded above this crossing (see sketch). The 18" culvert is installed high in the fill and has a 20' 1/2 round downspout installed. Flow in the channel goes subsurface and not into the inlet. There is a sinkhole at the inboard road to the right of the culvert. A small berm has been created to concentrate flow to the culvert inlet. A small dip to the right of the culvert prevents diversion potential at this time. The steep outboard fill appears stable. 276' of the right approach drains to this site. The low excavation rate is due to the long outboard fill. | M | 0 | 276 | 320 | M | 1. Excavate the crossing from TOP to BOT. Install a 24"x80' culvert in the stream axis at channel grade.<br>2. Add a critical dip to the left hingeline.<br>3. Armor the outboard fill with 48 cy of 1'-2' rock.<br>4. Install 2 rolling dips to the right approach.<br>5. Outslope the road and fill the ditch for 276' to the right. |
| 586 | Stream cro | A 1'x1' Class 3 stream initiates 100' above the road. The flow has eroded a 1'x1' gully in the roadbed that expands to 8'wx5'dx25'L down the outboard fillslope. A headcut in this gully is migrating into the road surface. The road is dipped at the left hingeline to prevent diversion and this is where the erosion occurs. 1497' of the right approach is level/outsloped with no berm and a few dips. There are logs buried in the outboard fill. | ML | 0 | 1497 | 164 | M | 1. Excavate the crossing from TOP to BOT. Install a 24"x70' culvert in the stream axis at channel grade.<br>2. Install a critical dip on the left hingeline.<br>3. Add 10 rolling dips to the right approach.<br>4. Armor the outboard fillslope with 40 cy of 1'-2' rock. |
| 587 | Stream cro | This is an oversized culvert for the channel dimensions. The culvert is set shallow to the natural channel grade. The outlet has a 10' 1/2 round downspout. Flow from the downspout has eroded a 5' knickpoint into the lower outboard fill. The area below appears stable. Lots of dead Tan Oaks in the channel above and below the crossing. | L | 0 | 350 | 176 | ML | 1. Install a critical dip along the left hingeline.<br>2. Install a 24"x20' downspout.<br>3. Install 2 rolling dips up the right approach.<br>4. Remove the existing trash rack and install 24" above the inlet. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 588 | Stream cro | This is a very small 1'x1' Class 3 stream that initiates 75' above the road. There is very little erosion here. An armored fill will work here. 362' of right approach and 200' of left approach drain to this site. The roadbed is well vegetated with 10'-20' Firs growing on the road prism. | L | 200 | 362 | 37 | L | 1. Dip out the road and install an armored fill crossing using 20 cy of 1'-2' rock.<br>2. Install 2 rolling dips to the right approach and 1 rolling dip to the left approach. |
| 589 | Stream cro | This site has a mossy bedrock stairstep channel bottom. The fillslopes were about 80% pulled and the stream has since washed out the rest. Old landslide/torrent deposits exist in the active stream channel both above and below the crossing. | | 150 | 0 | 3 | | No Treat |
| 590 | Stream cro | This bridge over a possible Class 1 stream is constructed of 4' diameter logs placed across the stream with steel angle iron on top installed in the stream axis with geo-textile and 2' of coarse road rock on top of this (22'x2'x40'=65 cy). There are 3'-5' diameter boulders placed at the channel walls to form buttresses (see sketch), this creates a 3'hx8'w channel that seriously constricts the stream flow. There are 2 large logs stuck under the bridge. Bedrock/boulder cascading channel beyond the bridge is polished by accelerated stream flow. An abrupt critical dip on the right hingeline has caused a 5'wx4'dx15'L= 11 cy erosion hole in the outboard fill. The approaches from both directions on the left bank (900' total) deliver to this crossing causing voids behind buttress boulders. Humboldt logs on the left bank suggest this is not the first structure across this stream. Expect low excavation times as this is very large material. No equipment times for bridge removal and installation are calculated here due to budget constraints, but treatments for both segments of the left approach should be conducted.<br><br>6/6/07 JG The boulders, logs, bridge and the rock on top will need to be pulled to replace the bridge or decommission the site. Some sediment is stored upstream, but this is very coarse material and should work through the system on its own. The stream may be a Class 1 with significant subsurface flow, but it is severely constricted - trim lines in the duff are level with the bridge after a relatively dry winter. Upgrade would be expensive for a new bridge, but decommision would be relatively straightforward. The existing "bridge" is not re-usable. The gully on the hingeline is headcutting and will continue to erode to 4x3x40 = 18 cy. The channel is aggraded; 1/4 mile upstream there is a lot of flow, but dry at the bridge. | H | 900 | 0 | 65 | H | 1. Remove the bridge. Widen channel by 5' on each bank, lay back banks to 2:1. Install a 60' flatcar bridge (use the bridge from site #556). Excavate 65 cy of material on bridge (22'w x 2'd x 40' long) + 35 cy on each bank = 135 cy total. Stockpile locally.<br>2. Armor both banks with 2-3' riprap (30' long x 10' high x 3'deep) = 70 cy.<br>3. Decommission 450' of the left approach toward site # 591 (see sketch).<br>4. Remove 300' of berm on lower segment of the other left approach.<br>5. Outslope 400' of the lower segment of this same approach<br>6. Install 9 rolling dips on the left approaches. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 591 | Stream cro | This landing has been pushed up against a Class 2 stream. Flow saturates landing fill causing cracks at the edge of a steep fillslope. Most of this seepage diverts down the landing and then down the road causing deep gullies down the road surface and eventual partial delivery to Site # 590. This stream should be day lighted across this landing and the road down to Site # 590 decommissioned.<br>6/6/07 JG - A network of skidtrails above this landing contributes flow and has disrupted the natural channel. It's difficult to tell where the flow comes from to form the gullies on the road. It may be necessary to address the skids to truly solvethis problem. The stream has been pushed to the right around the landing, so pulling the right side of the landing would help to minimize erosion on the landing edge and could reduce the flow down the road. The skid above the debris pile shows no evidence of concentrated flow. Changed the treatment immediacy to moderate. | H | 0 | 0 | 700 | HM | 1. Excavate from TOP to BOT. Store spoil on the inside of the landing.<br>2. Decommission the road down to Site # 590 by outsloping 450' of road and installing 9 cross road drains.<br>6/6/07 JG - The excavation will pull the right edge of the landing to better establish the channel, minimize left bank erosion around the landing, and disconnect the stream from wet landing areas. |
| 592 | Stream cro | A 24" culvert drains this steep 3'x1' Class 2 stream. The culvert is installed high in the fill and the upper 4' of the pipe is exposed. The steep, hard bedrock channel above the inlet spreads the flow and the inlet is so close to the bedrock due to the narrow road width that a lot of the flow goes across the road surface and washes away the material covering the pipe. The steep outboard fill is heavily armored with 3'-5' boulders, and except for a small notch on the up-road side of the outlet, is doing well. The channel above the inlet is mossy and well vegetated. 460' of the left approach delivers to the site. | M | 460 | 70 | 43 | M | 1. Excavate the crossing from TOP to BOT. Replace with a 24"x50' culvert at the base of the fill in the stream axis. Reuse boulders<br>in the outboard fill and fill from the landing 75' to the left of the crossing to move the road out 4'.<br>2. Armor the outboard fill with<br>3. Install 3 rolling dips up the left approach. |
| 593 | Stream cro | This steep, rowdy 4'x1' Class 2 stream is drained by a rusted 24" culvert. The inlet is 25% plugged with sediment. The pipe is short and installed high in the fill. There is a fillslope failure to the right of the crossing that suggests the culvert overtopped and diverted in the past. The bedrock channel inhibits trash rack installation. 1183' of left approach drains to this site, it is generally outsloped mildly with no berm. | M | 1183 | 0 | 71 | HM | 1. Excavate the crossing from TOP to BOT. Replace with a 30"x40' culvert placed in the stream axis at channel grade.<br>2. Add a critical dip to the right hingeline.<br>3. Install 8 rolling dips to the left approach.<br>4. Armor the outboard fillface with 20 cy of 1'-2' rock. |
| 594 | Stream cro | A 3'x1' Class 3 stream with a pulled crossing. Negligible fill remains. The channel slopes are well laid back, vegetated and stable. The channel is at grade. 250' of the right approach drains to this site, but it has 2 robust crossroad drains and is disconnected. | L | 0 | 250 | 2 | | No Treat |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 595 | Stream cro | A pulled crossing on this long ago decommissioned road. No fill remains in the crossing. The channel walls are laid back at better than 2:1 and stable. The channel is at grade. The approaches do not deliver. | L | 0 | 85 | 0 | | No Treat |
| 596 | Stream cro | This site is a pulled crossing on a 2'x1' Class 3 stream. The channel is at grade and the channel walls are stable. The left approach is well water barred with no road flow making it to the stream. | | 350 | 20 | 0 | | No Treat |
| 597 | Stream cro | This site is a pulled crossing on an even gradient Class 2 or 1 stream. The roadbed between Sites # 597 and 598 is on sandstone bedrock. The left road approach is nonexistent until the road climbs out of the active channel and heads up the hillside above the left bank. | L | 0 | 0 | 0 | | No Treat |
| 598 | Stream cro | This site is a stream crossing across a landing. The crossing has been pulled and is now located in a more natural alignment, whereas it used to be diverted down the right approach, cutting a deep gully and removing about 100' of road prism. The approaches are heavily overgrown with Fir trees and Whitethorn. No fill remains in this crossing. The channel walls are laid back to 2:1 and appear stable. | L | 20 | 0 | 0 | | No Treat |
| 599 | Stream cro | This site is a pulled stream crossing near the confluence with a Class 2 (1) stream. The road is on an abandoned floodplain. The roadbed is dense with Fir trees and Whitethorn. The pulled fillslopes are about 1' high and mossy. | | 0 | 0 | 0 | | No Treat |
| 600 | Stream cro | This is a pulled crossing. The rowdy channel above the site may be getting extra contributions from a skid road above. Again, like Site # 599, The road is abandoned on a floodplain. There is very little fill here. | L | 0 | 0 | 0 | | No Treat |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 601 | Stream cro | This is a partially pulled crossing on a major tributary of Signal Creek. A 40' long log supports the fill on the right bank (low erosion potential). The left bank/fill is a 12' high vertical, mossy slope (moderate low erosion potential). The log and fill on the right bank appear to constrict the channel from being 18' wide to about 10' wide. The logs in the channel contribute some scouring effect and should be removed. | M | 0 | 0 | 49 | M | 1. Excavate the fill and log along the right bank laying the slope back to 2:1. Keep the thalweg away from the left bank.<br>2. If possible, pull back the left bank to 2:1.<br>3. Store spoil locally on adjacent landing.<br>Right bank: 38x5x10=70 cy x1.2=85 cy.<br>Left bank: 35x12x24=373 cy x1.2=448 cy. |
| 602 | Stream cro | A washed out crossing of a 20' x 3' class 2 stream. A 3' diameter saw log buried in the fill on the left bank suggests a log bridge at this location at one time. Channel walls appear to constrict the channel slightly and the walls are near vertical but well vegetated and mossy. This crossing should be decommissioned.<br>If this road is to be upgraded, a bridge would be the sound treatment here.<br>Estimate excavation to be 6x6x40 = 53cy to lay back both banks to 2:1. Also, 30cy of 3' diameter rock to armor the banks (40'l x 6'h x 3'd) and install a 60' boxcar bridge.<br>Future erosion is from banks laying themselves back. | ML | 468 | 190 | 53 | ML | 1. Lay back stream banks to a 2:1 gradient and armor 40' x 6' x 3' deep on both banks with 2-3' riprap.<br>2. Install a 60' flatcar bridge.<br>3. Install 3 rolling dips to left approach and 1 to the right. |
| 603 | Landslide | This is an outboard fill failure on an older unused road. The lower portion of the failure is being supported by two 50' long browlogs. The logs are about 10' below the outboard surface of the road. About 6' of the outer road width has failed (previous to brow log installation). The cutbank is highly fractured bedded sandstones. The current passable road width is about 10' and could be wider if talus were removed from the base of the cutbank. There is a bedrock outcrop on the right hingeline of the failure. This is a check site: may need an engineered fill if upgraded. | ML | 0 | 800 | 96 | ML | 1. Excavate along the outboard road from START to END flags removing unstable fill. 60'w x 3'd x 18'L = 120 cy<br>2. Store spoil down the left road near Site # 602 (200')<br>3. Outslope the road and fill the ditch for 800' to the right and install 5 rolling dips.<br>* Equipment hours do not account for engineered fill rebuild; may be able to achieve adequate road width by removing talus along the base of the cutbank, but the fillslope may still need to be supported. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 604 | Stream cro | The road has been dipped through the crossing to keep the stream from diverting. The stream has headcut from the BOT up to the outboard road surface. Some sediment remains perched on top of large woody debris on the fillslope. The channel is mossy across the roadbed. The channel above the crossing is filled with skid fill.<br>* Treatment immediacy is based upon the need to completely excavate fill rather than need to install a culvert.<br>The lowest log on the outboard fill may need to remain because it is supporting fill on the right hingeline. | M | 30 | 400 | 107 | M | 1. Excavate the crossing from TOP to BOT to install a 24"x70' set in at channel grade.<br>2. Install a critical dip along the left hingeline.<br>3. Install a single post trash rack 24" above the inlet.<br>4. Armor the lower 1/4 of the outboard fillslope wit 5 cy of 1'-2' rock.<br>5. Outslope the road and fill the ditch for 400' to the right.<br>6. Install 2 rolling dips to the right. |
| 605 | Stream cro | This is a small steep stream with a pulled crossing. Very little fill remains in this mostly fractured bedrock channel. The hydrology in this area is highly disturbed by a large landing (see sketch). 389' Of the right approach delivers to this site. | ML | 0 | 389 | 5 | L | 1. Dip out the crossing and install an armored fill crossing using 10 cy of 1'-2' rock<br>2. Add 3 rolling dips to the right approach. |
| 606 | Other | This landing appears to have pushed the stream flow out of it's natural channel. Can't say the stream has been diverted because no other channel was found. On the left hinge of the landing (at Site # 605) the stream had diverted across the road and gullied down the hillside. The stream along the inboard portion of the landing appears constricted and portions of shallow fill are slowly failing, as well as on the stream bank on the opposite side. | ML | 0 | 0 | 37 | | No Treat |
| 607 | Stream cro | A large rowdy Class 3 stream had the crossing pulled. Very little fill remains in the crossing and this is from the over steepened right bank (see sketch) About 10 cy of this material from the right bank will need to be pulled for proper culvert alignment. | ML | 0 | 2700 | 10 | ML | 1. Remove the remaining fill and install a 48"x 70' culvert .<br>2. Install a critical dip to the left hinge.<br>3 Add 18 rolling dips to the left approach. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 608 | Stream cro | This is a rocky talus fill stream crossing. The road was dipped to keep the flow in the channel. The stream has been headcutting back through the road fill. The left outboard fillslope is contributing talus colluviums to the channel. | ML | 175 | 100 | 34 | ML | 1. Excavate the crossing from TOP to BOT to install a 24"x40' culvert in the stream axis at channel grade.<br>2. Outslope the road and fill the ditch for 100' up the right approach.<br>3. Outslope the road and fill the ditch for 175' up the left approach.<br>4. Install 1 rolling dip up the left approach.<br>5. We may need to raise the road 2' in order to accommodate a 24" culvert. |
| 609 | Stream cro | This is a pulled crossing on a 9'x2' Class 2 stream. There is a confluence with a steep 3'x1' Class 2 with a bedrock channel just above the inboard road. Three logs in the channel below the crossing appear to have been placed as buttresses, but stream flow got in behind them and scoured out a landslide on the right approach. (see sketch) The stream appears to be at grade in the boulder /bedrock channel. The channel walls are over steepened and constricting until opened by a fill failure on the right bank. Lots of wood in the fill and constricted space lowers the production rate. 450' of the left approach delivers to this site. | M | 450 | 0 | 254 | M | 1. Excavate TOP to BOT. Install 54"x70' culvert in the axis at grade.<br>2. Add a critical dip to the right hinge.<br>3. Install 3 rolling dips up the left approach. |
| 610 | Stream cro | This is a partially pulled crossing that has since been about 80% washed out. The stream is currently flowing above the crossing only. Looks like a rocky torrent deposit exists both above and below the crossing. There is a 10' vertical wall of rocky material at the inboard road. The stream looks to be pretty much down to bedrock through the roadbed though bifurcated. The majority of future erosion will be from road fill at the outboard road on the right hingeline. | M | 1000 | 0 | 11 | M | I do not think a culvert could be placed here because the perched material at the inboard road would eventually plug the culvert.<br>1. Install an armored fill crossing using 60 cy of rock armor.<br>2. Outslope the road and fill the ditch for 1000' up the left approach.<br>3. Install 6 rolling dips up the left approach. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 611 | Stream cro | This 3'x1' Class 2 stream crossing has been pulled. The channel is at grade. The channel above the crossing has been skidded. The banks appear stable and mossed over. One hour of excavator time to dress the channel and 6 hours for culvert installation and backfill are the requirements here. 240' of the left approach delivers to the site. There will be diversion potential to the right if a culvert is installed. | L | 240 | 0 | 0 | L | 1. Dress the channel for culvert installation ( 1 hour) Install the culvert in the stream axis. The backfill material is available on site.<br>2. Add a critical dip to the right hingeline.<br>3. Install 2 rolling dips up the left approach<br>4. Install an 18"x30 ditch relief culvert to drain the spring at the top of the reach.<br>5. Outslope the road and fill the ditch for 240' to the left. |
| 612 | Stream cro | This is a pulled crossing. It appears to be a remaining Humboldt log on the left hinge at the outboard road. There are small fir trees growing in the fill. The channel looks stable and near grade. There is 1 small (2.5') headcut in the road bed. | ML | 250 | 200 | 68 | ML | 1. Excavate from TOP to BOT. Install 42"x70' culvert in the axis at grade.<br>2. Outslope the road and fill the ditch for 200' to the right and install 1 rolling dip.<br>3. Outslope the road and fill the ditch for 250'to the left and install 2 rolling dips.<br>4. Armor lower 1/4 of outboard fillslope with 10 cy of 1'-2' rock |
| 613 | Stream cro | This is a partially pulled crossing of a 3'x1' Class 3 stream. Stream flow has eroded a 6' headcut that has eroded the outboard half of the roadbed. Logs at the outboard fill retain some fill. There are 6"-8" trees growing on the roadbed. 460' of the right approach delivers to this site. | M | 0 | 460 | 374 | M | 1. Excavate TOP to BOT. Install a 24"x80' Culvert in the stream axis at channel grade.<br>2. Add a critical dip to the left hingeline.<br>3. Install 3 rolling dips up the right approach.<br>5. Outslope the road and fill the ditch for 460' to the right. |
| 614 | Stream cro | Bedrock hillslope above crossing under redwood canopy. Channel bottom is rocky though crossing. Fillslopes are near vertical, mossy, and dense with herbaceous vegetation. Small fir trees growing on road bed. | L | 0 | 800 | 0 | L | 1. Excavate crossing from TOP to BOT to install a 24" x set in at channel grade.<br>2. OSR-FD for 800 feet up right road.<br>3. Install 6 rolling dips to right.<br>4. Install a critical dip along left hingeline. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 615 | Stream cro | This is a pulled crossing. The channel bottom is covered with leaf litter. The fillslopes are over steepened and densely covered with herbaceous vegetation. There is a 3' stable knickpoint in the middle of the crossing. | L | 0 | 400 | 50 | L | 1. Excavate the crossing from TOP to BOT and install a 24"x50' culvert. Raise the inboard road 1' to accommodate the culvert.<br>2. Install a critical dip along the left hingeline.<br>3. Install a single post trash rack 24" above the inlet.<br>4. Armor the lower 3/4 of the outboard fillslope with 22 cy of 1'-2' rock. |
| 616 | Stream cro | This 3'x1' Class 3 stream has a pulled crossing. The area is very densely vegetated including the channel bottom and fillslopes. The crossing doesn't look to receive very much flow. There is a bedrock knickpoint at the inboard road. | L | 0 | 200 | 6 | L | 1. Excavate the crossing from TOP to BOT and install a 24"x40' culvert set at channel grade.<br>2. Install a critical dip along the left hingeline.<br>* Raise the roadbed 2' to accommodate the culvert. |
| 617 | Road surfa | This off-road drain is at the lower portion of a long undrained stretch of road. The roadbed is covered with vegetation and duff. There is minimal sign of conductivity from drain to the creek. | L | 950 | 0 | 0 | L | 1. Install 19 cross road drains to left road. Only rip road surface to road intersection to left at site #618 and #619. |
| 618 | Landslide | This landslide of road fill appears to be caused by failure of an old log bridge at Site # 619. Bridge logs in the channel have diverted flow to the right, eroding the right bank/fillslope and causing failure into the stream. Road width prevents pulling back the fill. An engineered fill will be required if the road is to be upgraded. Removal of the remains of the log bridge from the creek to allow the stream to resume natural alignment should be considered. 310' of the left approach delivers to a waterbar that outflows onto the slide. | M | 310 | 200 | 129 | M | 1. Decommission site: excavate 259 cy of unstable road fill and stockpile locally against the cutbank.<br>2. Remove remnants of old bridge from stream and better define channel to prevent further scour.<br>3. Install 5 cross-road drains to the left and 3 to the right. |
| 619 | Stream cro | This is a 100% pulled crossing. Road bed is totally revegetated. Stream banks through the old crossing look very stable. An 8 foot exposed portion of bedrock is in the middle of the crossing. Another rock outcrop at the OBF of right road constricts stream flow just below crossing. A log jam of what may have been an old bridge below rock outcrop is causing stream flow to erode fill at site #618. | L | 1240 | 40 | 0 | L | 1. Install 15 cross-road drains to the left and 1 to the right. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 620 | Stream cro | A 4'x1' Class 2 stream has been diverted to the left of the natural axis by possibly a Humboldt crossing (logs in the fill suggest this). This old crossing has been partially dug out and stream now flows through a curved trench with vertical, calving sideslopes. Restoring the natural channel and installing a broad, armored fill crossing should be considered here. 700' of right approach drains to this site. The large pile of large saw logs piled in the channel downstream of the road will lower the excavation production rate. | HM | 0 | 700 | 22 | M | 1. Decommission stream crossing. Excavate from TOP to BOT giving stream a 5' wide channel. Lay back banks 2:1.<br>Spoil locally.<br>2. Rip road and install 14 cross road drains to right. |
| 621 | Stream cro | There is an old debris torrent deposit about 60' up channel from this crossing. The stream is presently flowing another 60' above that. The deposit has caused the flow to fan out into various channels. The flow coalesces into one channel above the crossing. The road bed was only dipped through the crossing. The flow has since incised down to the present grade. The flow looks constricted. Fillslopes are near vertical but look relatively stable. The crossing is on the right hingeline of a landing. | ML | 20 | 50 | 28 | ML | 1. Excavate the crossing from TOP to BOT. Give stream a 7' channel width and lay banks back 2:1.<br>Spoil locally. |
| 622 | Stream cro | This appears to be diverted flow above the road from the stream at Site # 621. This area appears to receive flow only during storm events. The flow has headcut from the outboard fill back into the roadbed. This crossing is on the right side of a landing. The headcut is somewhat naturally armored with 6" minus rock. | ML | 250 | 0 | 38 | ML | 1. Decommission crossing. Excavate from TOP to BOT. Give channel a 4' channel width. Layback banks 2:1.<br>Spoil locally.<br>2. Rip road and install 5 cross road drains to left. |
| 623 | Stream cro | A small steep Class 3 stream has been dammed with a berm at the inboard side of the road. There is a sediment fan behind the berm. The road has been dipped with a berm on the downhill hingeline. 250' of the left approach drains to this site. | ML | 250 | 0 | 204 | ML | 1. Excavate the crossing from TOP to BOT. Give stream a 4' channel width and lay back banks 2:1.<br>Spoil locally on landing to left.<br>2. Rip road and install 5 cross road drains to left. |
| 624 | Stream cro | This is a very old pulled crossing. The roadbed has mature 1'-2' dbh Fir trees growing on it. It doesn't look like the road ever crossed the stream. The hillslope on the other side of the stream has evacuated areas of past hillslope debris slides which could have been the road. | | 0 | 0 | 0 | | No Treat |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 625 | Stream cro | A small (4'x1') class 3 stream crosses an abandoned spur road. No road fill appears to be present at the crossing. The creek meanders and loses much of its load approximately 50' downstream from the crossing before entering the adjacent class 2 creek. A small berm has developed parallel to the stream on the right bank. Approximately 1485' of right road drains to this stream; however, it is grassed over and appears stable, and does not appear to be delivering sediment to the stream. Along this stretch of road one large cut-bank slide and several smaller slides are blocking the road, and several gullys have developed in the road bed, though they appear to now be stable. Several water bars are present and appear to be working. A thru-cut road tying in from the right also contributes approximately 160 feet of road drainage. If this road is to be re-opened, this crossing should be upgraded to an armored fill crossing. Rock needs: 10 cubic yards 0.5-1' rock. | ML | 0 | 1485 | | | |
| 626 | Stream cro | A 2'x1' class 3 stream has had a shallow fill crossing pulled with the material used as a berm to prevent diversion to the left. No fill remains in the crossing but some fine sediment has been retained in the channel above the crossing by a 3' diameter saw log. Light rilling down the right approach is present but road bed is mossy and vegged. If this road were to be upgraded an armored fill would work here (40'w x 3'd x 8'w; 10 cubic yards of 0.5-1.5' rock). | L | 0 | 270 | | | |
| 627 | Stream cro | A 4x1 class 3 stream has diverted down the right road approach and formed a 2x2x50' gully on the road bed; a cut-bank slide forces flow off the road bed which has resulted in a 10x16x60' gully on the outboard fill slope. This outboard gully has incised to what appears to be bedrock, though a large precipitation event could force the fill to erode laterally. Approximately 875' of left road also drains to this site. | HM | 875 | 0 | 134 | M | 1. Decommission crossing by excavating from TOP to BOT. Lay back side slopes to 2:1. Stockpile excavated material in gully and locally.<br>2. Install 12 cross-road drains on left approach. |
| 628 | Stream cro | A 5x1 class 3 stream crosses the road- the crossing appears to have been partially pulled. A small (approximately 1' tall) berm has been placed parallel to the channel on the downhill side. Approximately 550 feet of right road drains to this site. | M | 0 | 550 | 102 | ML | 1. Excavate crossing from TOP to BOT.<br>2. Lay back sides 2:1.<br>3. Store spoil on road bed locally. |

| Site # | Problem | Comment on Problem | Eros. Pot. | Left ditch/road length (ft) | Right ditch/road length (ft) | Future Yield (yds3) | Tmt. Imm | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 629 | Stream cro | A small class 3 stream crosses a long-abandoned road; crossing is almost completely washed out with less than 5 cubic yards of fill remaining. 680' of left approach drains to the crossing, but the roadbed is densley vegged with brush with very little, if any delivery to the crossing. | L | 680 | 0 | 5 | | No treatment. |
| 630 | Stream cro | A 3x1 class 3 stream with disturbed hydrology due to saw logs causing scour and skids increasing flow outputs has diverted down the road approximately 70' to the right with minimal gullying on the roadbed. Large erosional gully (15'w x 10'd x 75'l) has formed down to class 2 stream. Gully sides are generally 2:1 and vegged with ferns and huckleberry. Head cut has been arrested by bedrock in the road prism, and appears to have stopped eroding. It appears little would be gained by excavating the very indistinct natural channel. ( )' of brushy left road approach contributes very little to stream crossing. This inner gorge road is almost in the stream on the lower end and is in poor shape. Recommend decommissioning. | ML | 300 | 0 | 312 | ML | 1. Excavate channel from TOP to BOT, lay back sides at 2:1 for decommissioning.<br>2. Install ( ) cross road drains to the left road appraoch.<br>3. Store spoil in old erosion gully and against cutbank locally. |
| 631 | Landslide | Long, slow deep-seated landslide has rechanneled hydrology on a large section of hillside. Mostly a done deal with intermittent areas of bare soil mostly above the road. Below the road are slump blocks- the presence of large stumps and vegetation below the road indicates some degree of stability, and any excavation would diminish this. Mapped streams appear to have been re-channellized and now appear as stable gullies. Long ago this area was logged and then experienced fire. Remaining roadbed is diminished in width, hummocky, and does not deliver. 1'-1.5' firs grow on remaining portions of roadbed, which just peters out. | ML | 400 | 0 | 1150 | | No treatment. |

# Appendix B.

## Typical Construction Drawings

### for Recommended Treatments on the Surveyed Roads within the Signal Creek watershed, Garcia River Forest Phase 1 Road Erosion Assessment, Mendocino County, California.

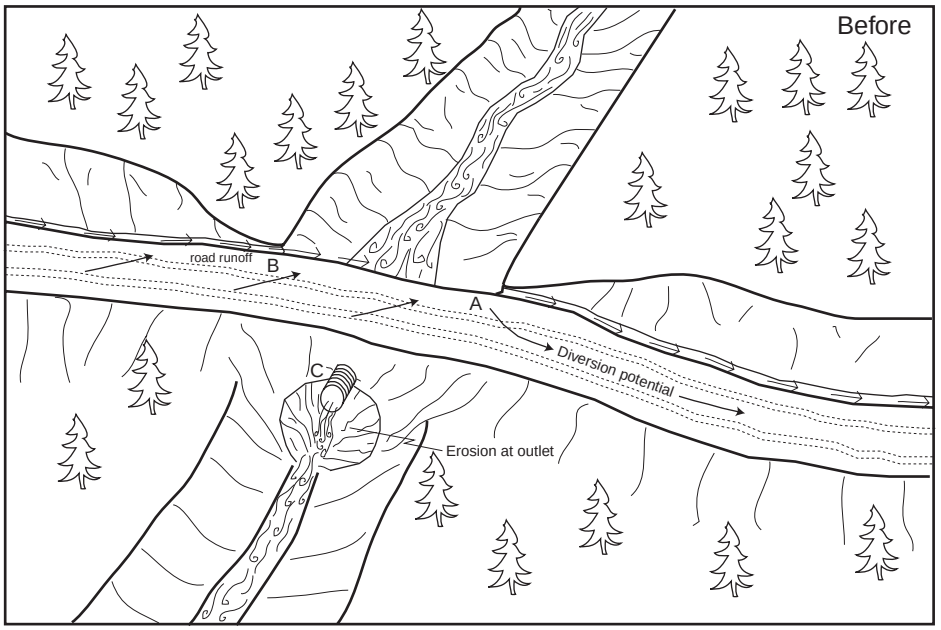
# Typical Schematic
# Components of an upgraded stream crossing

## Common problems

A - Diversion potential

B - Road surface and ditch drains to stream

C - Undersized culvert high in fill with outlet erosion

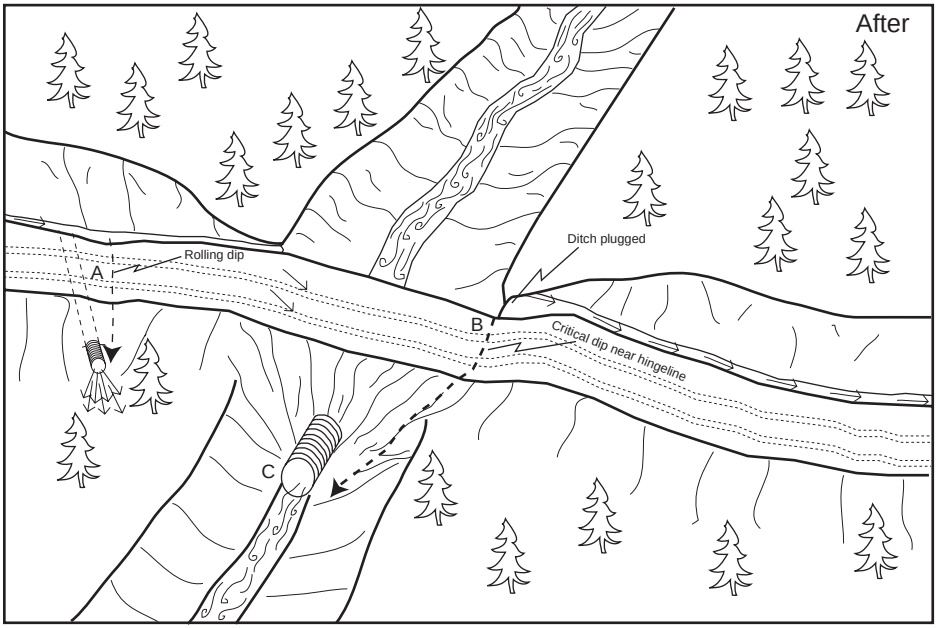



## General Standards

A - Road surface and ditch "disconnected" from stream

B - No diversion potential

C - 100 year culvert set at base of fill

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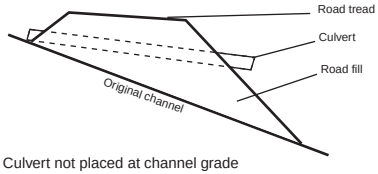
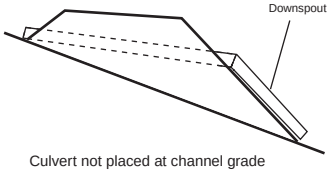
# Typical design of non-fish bearing culverted stream crossings

Existing



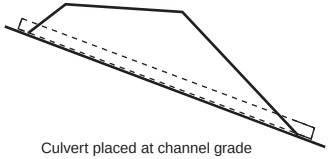

Culvert not placed at channel grade
Culvert outlet does not extend past base of road fill

Upgraded



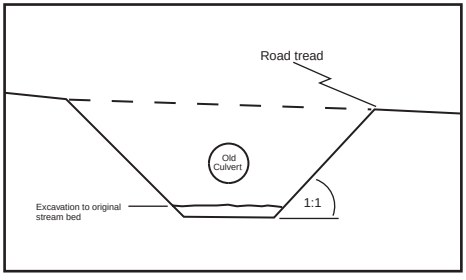

Culvert not placed at channel grade
Downspout added to extend outlet past road fill

Upgraded (preferred design option )

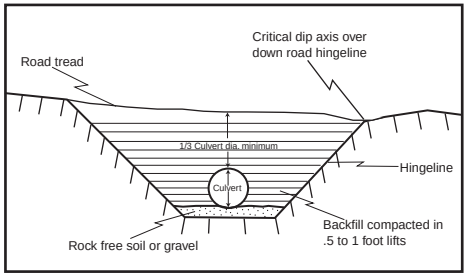


Culvert placed at channel grade
Culvert inlet and outlet resting on or partially in the original stream bed

Excavation in preparation for upgrading culverted stream crossing




Upgraded stream crossing culvert installation




## Typical installation of non-fish bearing culverted stream crossings

Road upgrading tasks typically include upgrading stream crossings by installing larger culverts and inlet protection (trash barriers) to prevent plugging. Culvert sizing for the 100 year flood flow should be determined by both field observation and calculations using a procedure such as the Rational Formula.

### Stream crossing culvert installation

1) Culverts shall be aligned with natural stream channels to ensure proper function, prevent bank erosion and debris plugging problems.
2) Culverts shall be placed at the base of the fill and at the grade of the original streambed or downspouted past the base of the fill.
3) Culverts shall be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
4) Culvert beds shall be composed of rock free soil or gravel, evenly distributed under the length of the pipe.
5) To allow for sagging after burial, a camber shall be between 1.5 to 3 inches per 10 feet culvert pipe length.
6) Backfill material shall be free of rocks, limbs or other debris that could dent or puncture the pipe or allow water to seep around pipe.
7) One end of the culvert pipe shall be covered then the other end. Once the ends have been secured, the center will be covered.
8) Backfill material shall be tamped and compacted throughout the entire process.
   -Base and side wall material will be compacted before the pipe is placed in its bed.
   -Backfill compacting will be done in 0.5- 1 ft lifts until 1/3 of the diameter of the culvert has been covered. A gas powered tamper can be used for this work.
9) Inlets and outlets shall be armored with rock or mulched and seeded with grass as needed.
10) Trash protectors shall be installed just upstream from the culvert where there is a hazard of floating debris plugging the culvert.
11) Layers of fill will be pushed over the crossing until the final, design road grade is achieved, at a minimum of 1/3 to 1/2 the culvert diameter.

### Erosion control measures for culvert replacement

Both mechanical and vegetative measures will be employed to minimize accelerated erosion from stream crossing and ditch relief culvert upgrading. Erosion control measures that are implemented will be evaluated on a site by site basis. Erosion control measures that may be employed include but are not limited to:
1) Minimizing soil exposure by limiting excavation areas and heavy equipment disturbance.
2) Installing filter windrows of slash at the base of the road fill to minimize the movement of eroded soil to downslope areas and stream channels.
3) Retaining rooted trees and shrubs at the base of the fill as "anchor" for the fill and filter windrows.
4) Bare slopes created by construction operations will be protected until vegetation can stabilize the surface. Surface erosion on exposed cuts and fills will be minimized by mulching, seeding, planting, compacting, armoring and/or benching prior to the first fall rains.
5) Extra or unusable soil will be stored in long term spoils disposal locations that are not limited by factors such as excessive moisture, steep slopes greater than 10%, archeology potential or proximity to a watercoarse.
6) On running streams water will be pumped or diverted past the crossing and into the down stream channel during the construction process.
7) Straw bales and/or silt fencing will be employed where neccessary to control runoff within the construction zone.

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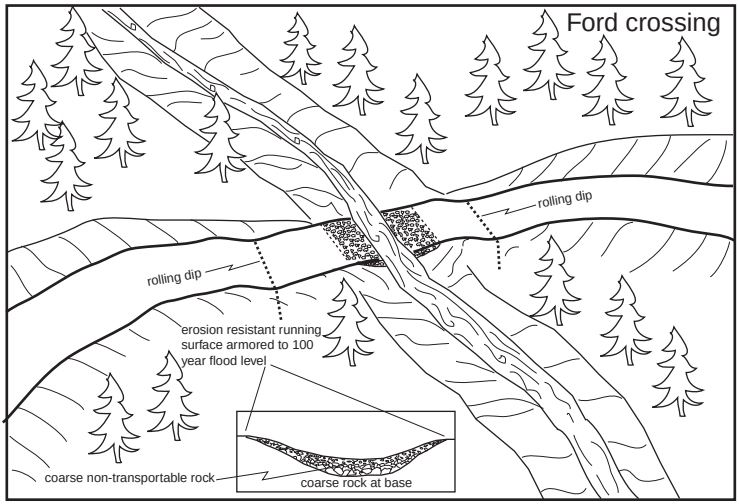
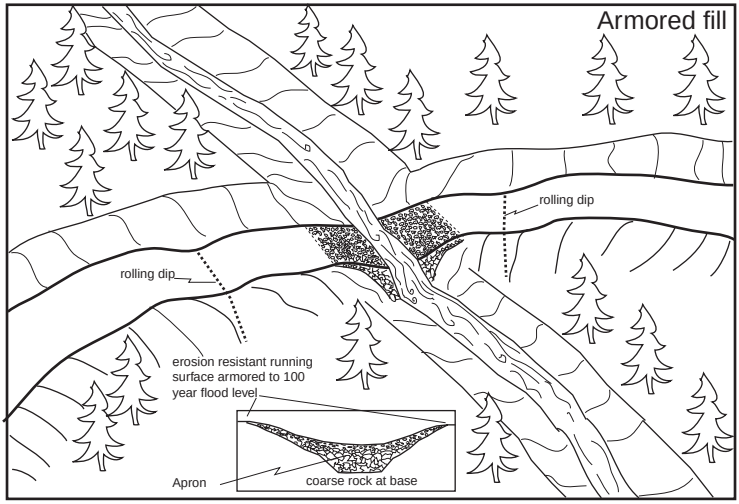
# Ford and armored fill stream crossings

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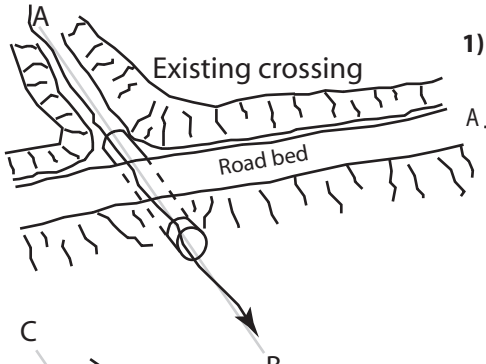
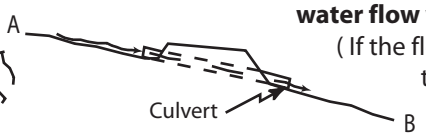
# 10 steps to building an armored fill stream crossing

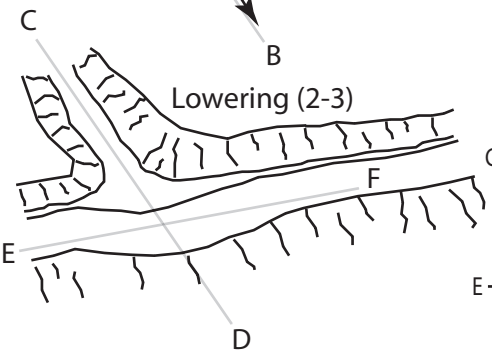


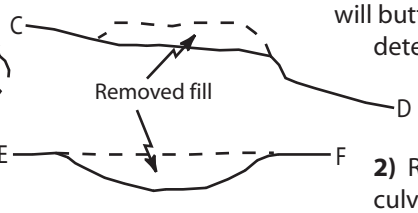




**Building an armored fill**

**1)** The two most important concepts to understand when constructing an armored fill are:

A) **The rock must be placed in a "U" shape across the channel so that the water flow will always stay confined within the armored area.** ( If the flow gets around the rock armoring it will quickly gully through the remaining road fill. Proper shaping of the remaining road fill and good armor placement will reduce the likelihood of crossing failure. )

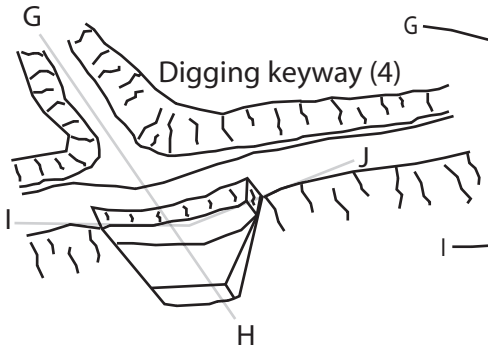


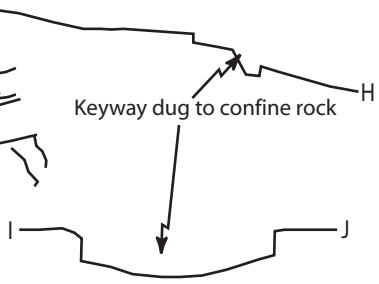




B) **The largest rocks must be used to butresss the rest of the rock armor in two locations:** 1b) The base of the armored fill where the road fill meets the natural channel. ( This will buttress the armor placed on the outboard road fill face and reduce the likelihood of it washing downslope.)

2b) The break in slope from the road tread to the outer fill face. ( This will buttress the fill placed on the outer road tread and will determine the "base level" of the creek as it crosses the road surface.)

**2)** Remove any existing drainage facilities including culverts and humboldt logs.

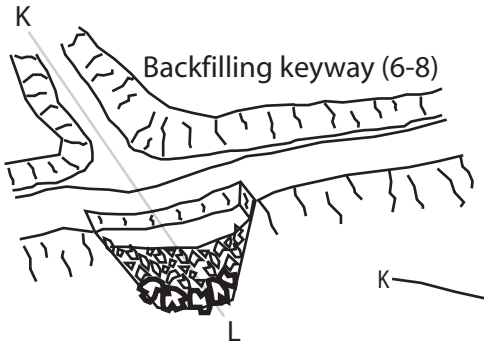


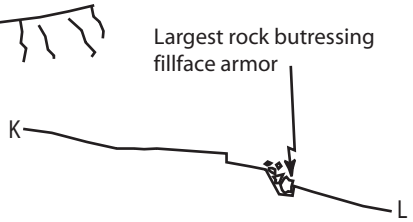




**3)** Costruct a dip centered at the crossing that is large enough to accomodate the 100 yr. flow event and prevents diversion. (C-D, E-F)

**4)** Dig a keyway (to place the rock in) that extends from the outer 1/3 of the road tread down the outboard road fill to where the outboard fill meets the natural channel, up to 3' into channel bed depending on site specific specifications. (G-H, I-J)

**5)** (Optional) Install geofabric within keyway to support rock in wet areas and to prevent winnowing of the crossing at low flows.

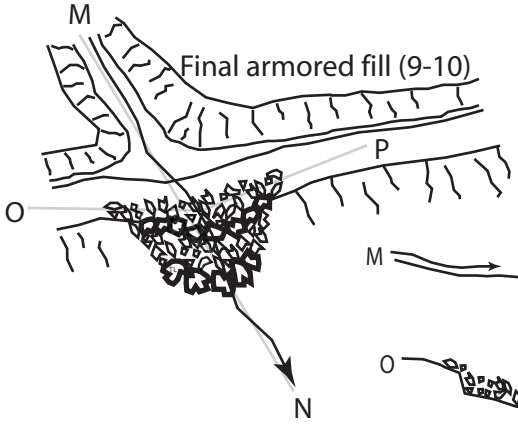


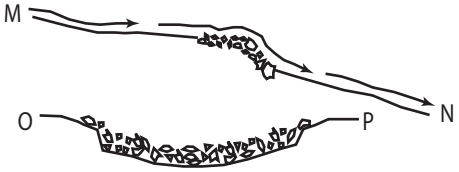




**6)** Put aside the largest rock armoring to create 2 buttresses in the next step. (K-L)

**7)** Use the largest rock available (as described in the treatment specifications at the site) to create a buttress at the base of the fill, (this should have a "U" shape to it and it will define the outlet of the aromored fill.)

**8)** Backfill the fillface with remaining rock armor making sure the final armored area has a "U" shape that will accomodate the largest expected flow. (K-L)



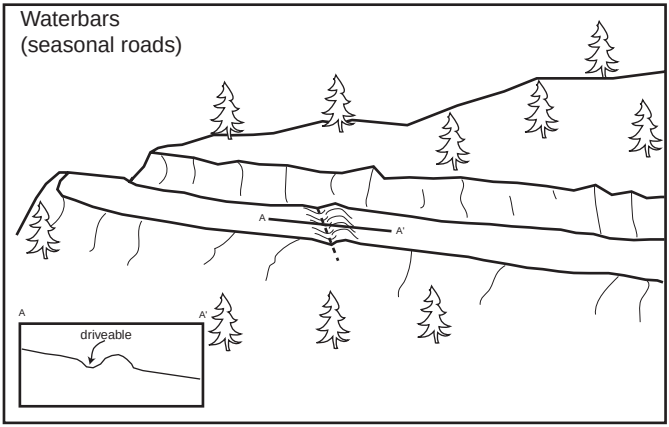



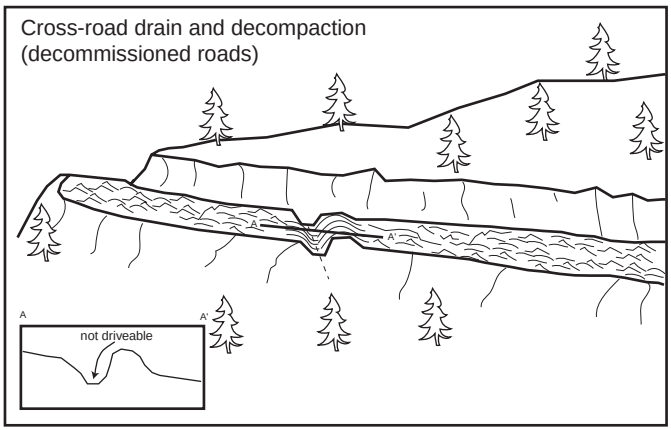

**9)** Install a second buttress at the break in slope between the outboard road and the outboard fill face, (this should define the base level of the stream and determine how deep the stream will backfill after construction.) (M-N)

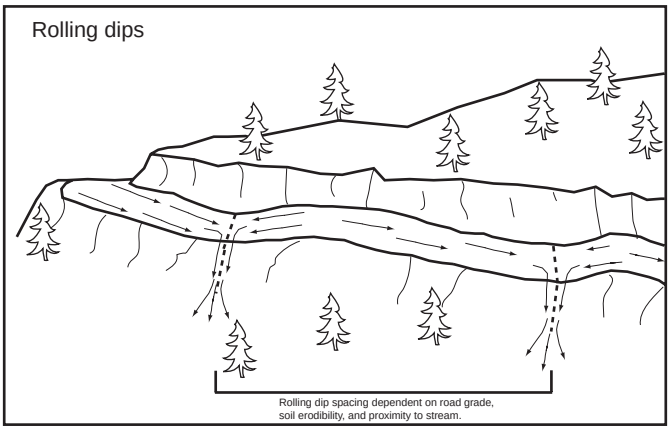
**10)** Back fill the rest of the keyway with the unsorted rock armor making sure the final armored area has a "U" shape that will accomodate the largest expected flow (O-P)

Pacific Watershed Associates (2005)

# Dispersing road surface runoff

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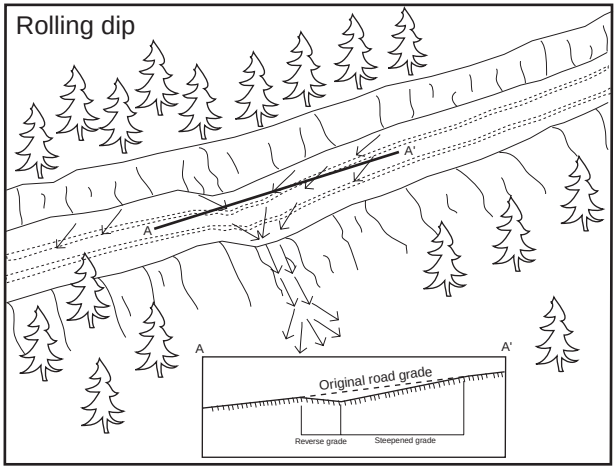
# Road surface drainage by rolling dips




**Rolling dip installation:**

1) Rolling dips will be installed in the road bed as needed to drain the road surface.
2) Rolling dips will be sloped either into the ditch or to the outside of the road edge as required to properly drain the road.
3) Rolling dips are usually built at 30-45 degree angles to the road alignment with cross grade of at least 1 percent greater than the grade of the road.
4) Excavation for the dips will be done with a medium size bulldozer or similar equipment.
5) Excavation of the dips will begin 50 to 100 feet up-road from where the axis of the dip is planned per guidelines established in the rolling dip dimensions table.
6) Material will be progressively excavated from the road bed, steepening the grade until the axis is reached.
7) The depth of the dip will be determined by the grade of the road (see table).
8) On the down-road side of the rolling dip axis a grade change will be installed to prevent the runoff from continuing down the road (see figure).
9) The rise in grade will be carried for about 10 to 20 feet then it will fall to the original slope.
10) The transition from axis to bottom, through rising grade to falling grade will be in a road-distance of at least 15 to 30 feet.

Table of rolling dip dimensions

| Road grade | Upslope approach (distance from up-road start of rolling dip to trough) (ft) | Reverse grade (Distance from trough to crest) | Depth below average road grade at discharge end of trough. (ft) | Depth below average road grade at upslope end of trough. (ft) |
|---|---|---|---|---|
| <6 | 55 | 15-20 | 0.9 | 0.3 |
| 8 | 65 | 15-20 | 1.0 | 0.2 |
| 10 | 75 | 15-20 | 1.1 | .01 |
| 12 | 85 | 20-25 | 1.2 | .01 |
| >12 | 100 | 20-25 | 1.3 | .01 |

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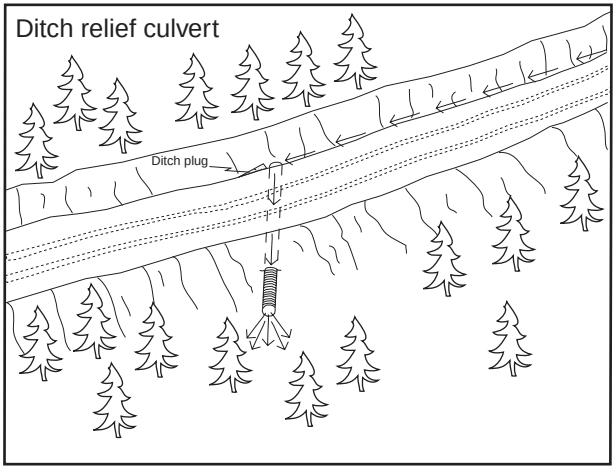
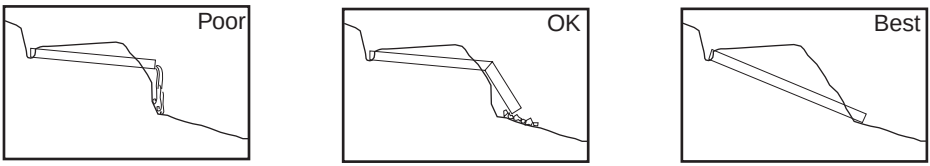
# Typical ditch relief culvert installation




Cross sections of typical installations




Ditch relief culvert installation

1) The same basic steps followed for stream crossing installation shall be employed.
2) Culverts shall be installed at a 30 degree angle to the ditch to lessen the chance of inlet erosion and plugging.
3) Culverts shall be seated on the natural slope or at a minimum depth of 5 feet at the outside edge of the road, whichever is less.
4) At a minimum culverts shall be installed at a slope of 2 to 4 percent steeper than the approaching ditch grade, or at least 5 inches every 10 feet.
5) Backfill shall be compacted from the bed to a depth of 1 foot or 1/3 of the culvert diameter, whichever is greater, over the top of the culvert.
6) Culvert outlets shall extend beyond the base of the road fill (or a flume downspout will be used).Culverts will be seated on the natural slope or at a depth of 5 feet at the outside edge of the road, whichever is less.

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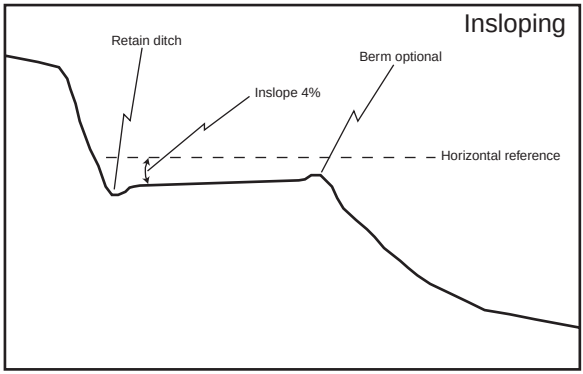
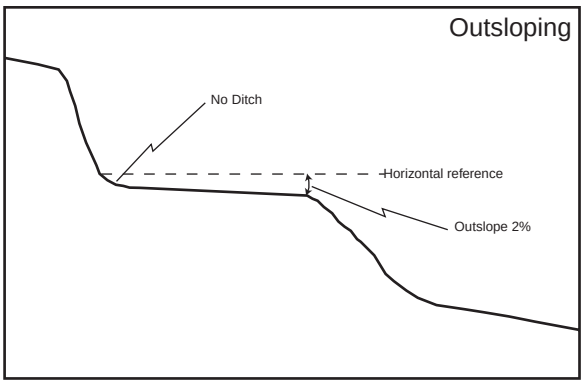
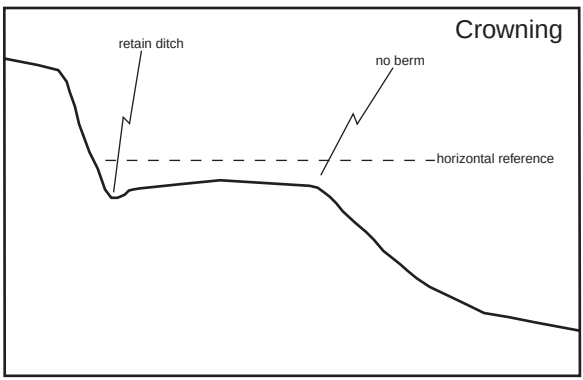
# Using road shape to control road runoff




| Outsloping pitch for roads up to 8% grade | | |
|---|---|---|
| Road grade | Outslope pitch for unsurfaced roads | Outslope pitch for surfaced roads |
| 4%, or less | 3/8" per foot | 1/2" per foot |
| 5% | 1/2" per foot | 5/8" per foot |
| 6% | 5/8" per foot | 3/4" per foot |
| 7% | 3/4" per foot | 7/8" per foot |
| 8%, or more | 1" per foot | 1 1/4" per foot |

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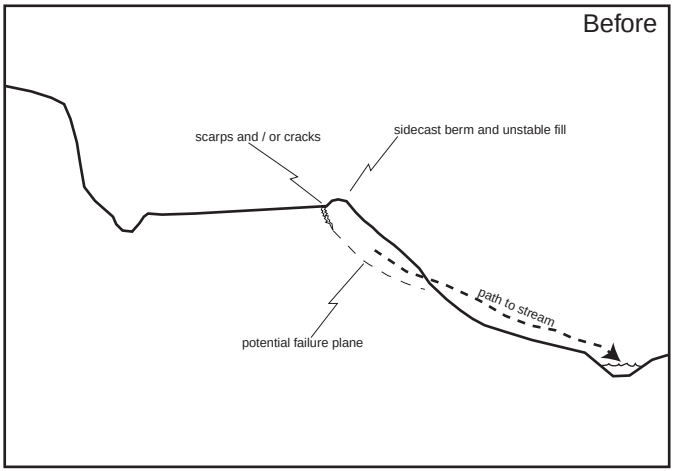
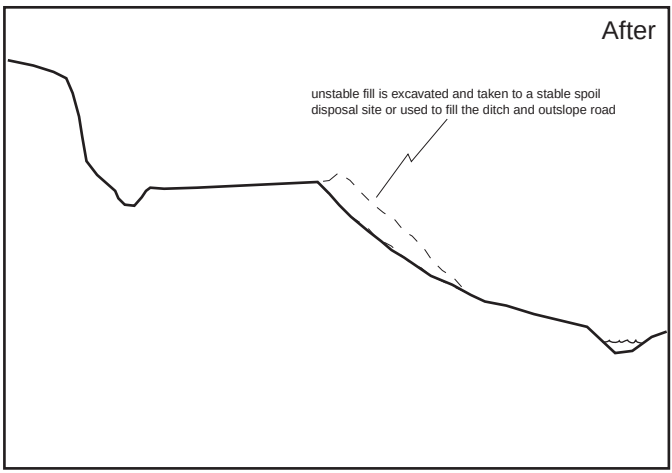
# Excavating unstable fill slope on maintained road

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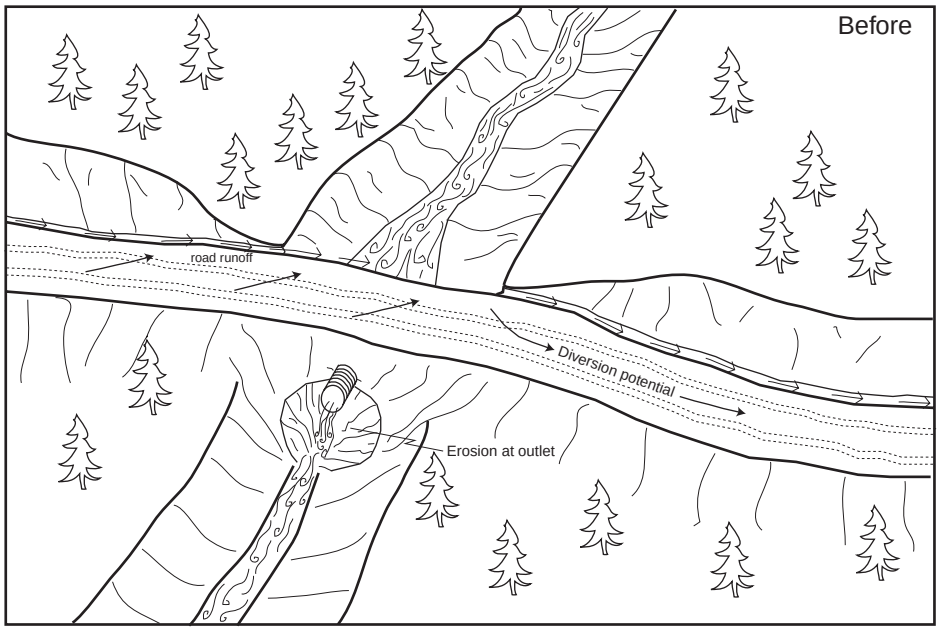
# Typical stream crossing decommissioning

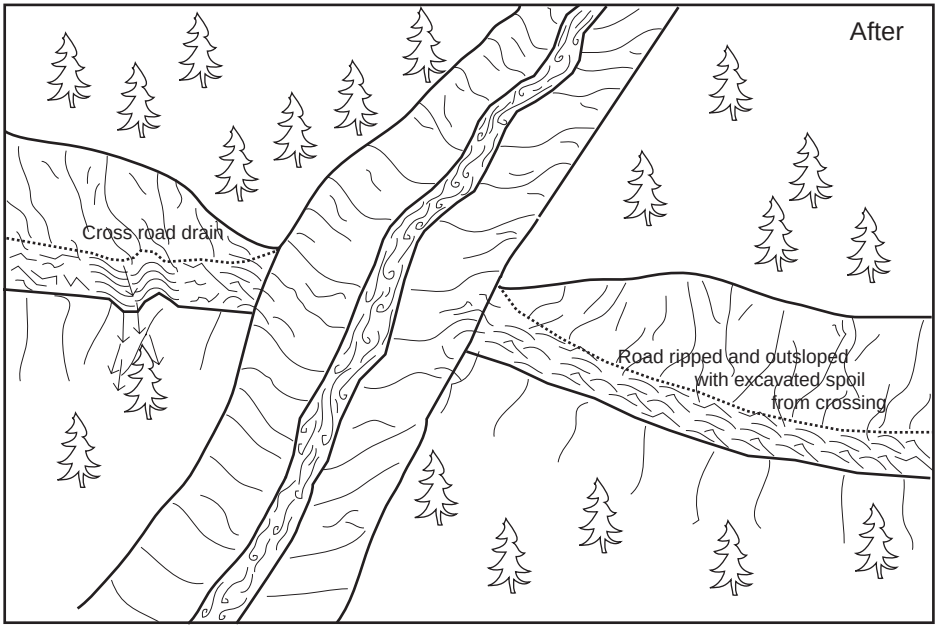
## Condition

- Diversion potential
- Road surface and ditch flows drain to stream
- Undersized culvert high in fill with outlet erosion




## Treatment

- Road surface decompacted
- Cross road drains on old road
- Stream crossing fill completely excavated
- Excavated spoil used to outslope adjacent road

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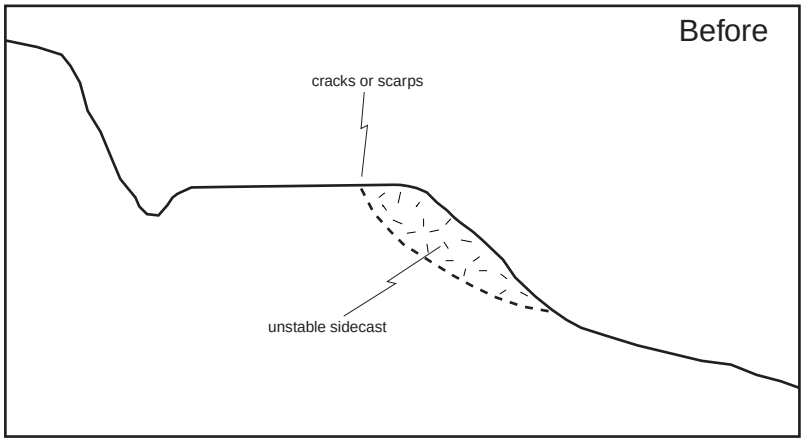
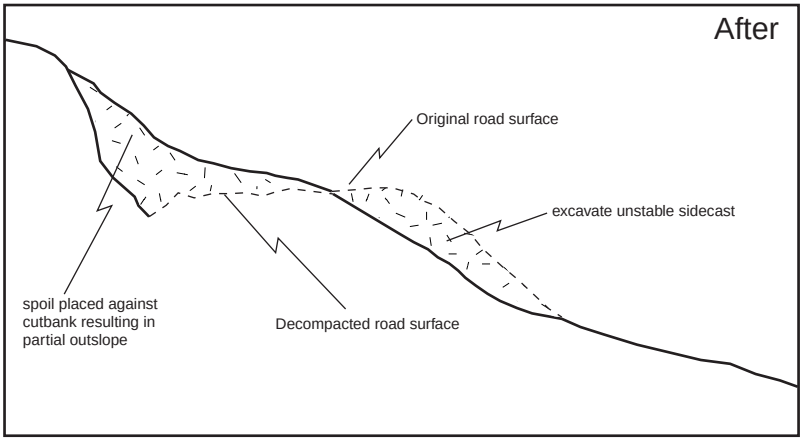
# Excavation of unstable fill slope on decommissioned road

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# Attachment B.

## Long Term Road Drainage and Erosion Control Plan for the Inman Creek and Indians Springs Watersheds, The Conservation Fund Garcia River Forest Phase 1 Assessment Mendocino County, California

PWA Report #08068302
March, 2008

**CDFG Fisheries Restoration Grant Program**
**Salmon and Steelhead Trout Restoration Account**
**Contract #P0430414**

PACIFIC WATERSHED ASSOCIATES

**Date:** February 19, 2007

**To:** Scott Kelly, Consulting Forester
Evan Smith, Director of Forestry Projects
Jenny Griffin, North Coast Program Manager
The Conservation Fund

**From:** Danny Hagans, Earth Scientist
Andy Casarez, Project Geomorphologist
Tom Leroy, Professional Geologist #7751
Pacific Watershed Associates, Inc.

**Subject:** Long term road drainage and erosion control plan for the Inman Creek and Indian Springs watersheds, The Garcia Forest, Garcia River watershed, Mendocino County, California.

Attached is the draft summary report for the road sediment source investigations conducted in the Inman Creek and Indian Springs sub-watersheds of the Garcia Forest. We are confident this preliminary report should satisfy The Conservation Funds TMDL submittal requirements for the Garcia River. This erosion control plan should guide future funding requests to implement the recommended treatments throughout the Inman Creek and Indian Springs sub-watersheds.

Thank you for the opportunity to evaluate and develop an erosion control plan for the roads within the Inman Creek watershed assessment area. We look forward to continued partnerships with you and your staff, and expect the projects to be completed with a very high degree of success over the next several years. If you have any questions, please contact me at (707) 839-5130.

Sincerely,

Danny Hagans

Danny Hagans

# Long term road drainage and erosion control plan for the Inman Creek and Indians Springs watersheds, Garcia River Forest.

## Summary Report

## Mendocino County, California

## February 19, 2007

**CDFG Contract #PO430414**
**Pacific Watershed Associates, Inc.**

*Prepared for:*
The Conservation Fund
P.O. Box5326, Larkspur, CA 94977
*and*
North Coast Regional Water Quality Control Board
5550 Skyline Boulevard, Suite A, Santa Rosa, California 95403

*Prepared by:*
Danny Hagans, Earth Scientist
Andy Casarez,, Project Geomorphologist
Tom Leroy, Professional Geologist #7751
Pacific Watershed Associates, Inc.
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Arcata, CA 95518-4433
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## 1. EXECUTIVE SUMMARY

During 2006, Pacific Watershed Associates, Inc., Arcata, California at the request of Chris Kelly, The Conservation Fund, conducted a Phase 1 assessment and sediment source investigation along a total of 64 miles of private timber access roads within the recently purchased "The Garcia Forest" property. The 24,000 acre Garcia Forest property is located east of the town of Point Arena, in southwestern Mendocino County, and is located solely within the Garcia River watershed. This report presents the results of the road assessment that was conducted in the Inman and Indian Springs sub-watersheds of The Garcia Forest.

The road assessment utilized the CDFG approved "Upslope Assessment and Restoration Practices" methodologies, described in the California Salmonid Stream Habitat Restoration Manual (Flosi and others, 2002). The methodologies provide a uniform, standardized and accepted protocol for identifying existing and potential erosion problems, and prescribing cost-effective treatments. The goals of the road assessment were to develop an erosion control and erosion prevention plan that, when implemented, would: 1) substantially reduce or minimize the risk of (potential for) future sediment delivery to nearby streams by improving road surface drainage and upgrading or decommissioning road drainage structures to accommodate the 24 hour, 100-year storm discharge (ie., to conform with current NOAA Fisheries, CDF&FP, CRWQCB and CDFG standards), 2) provide recommendations for upgrading or decommissioning the inventoried road routes, 3) where roads are recommended for upgrading, provide for year-round and safe use of the inventoried road routes, and 4) lower long-term road maintenance requirements and landowner costs.

The Phase 1 field inventories identified 408 active or potential sediment delivery sites that could deliver, if left untreated, approximately 44,000 $yds^3$ of sediment to nearby streams over several decades. The predicted future erosion is associated with stream crossing erosion and stream diversions, fine sediment production from "hydrologically connected" road reaches, and fill failure landslides along the inventoried roads. Each of the 408 sites of potential sediment delivery were: 1) prioritized for treatment based on the volume of future sediment delivery, likelihood of the erosion occurring in the near future, and several other factors, 2) prescribed with corrective measures to prevent future erosion, such as installing new, larger culverts, outsloping roads (with and without inboard ditches), constructing rolling dips, decommissioning stream crossings, de-watering gullies, etc., and 3) analyzed to develop estimated costs for implementing the recommended treatments.

We estimate a total of $928,700 will be needed to implement the erosion control and erosion prevention plan at the 308 sites recommended for treatment, and to minimize the risk of future sediment delivery along the 18.2 miles of currently hydrologically connected roads. The Conservation Fund and Pacific Watershed Associates will begin implementing the recommended erosion control and erosion prevention measures along 12.8 miles of Inman Creek roads during the summer 2007.

## 2. CERTIFICATION AND LIMITATIONS

The report entitled "**Long term road drainage and erosion control plan for the Inman Creek and Indians Springs watersheds, Garcia River Forest**" was prepared under the direction of a licensed geologist at Pacific Watershed Associates (PWA). All information provided in this report is based upon data and information collected by Pacific Watershed Associates.

The findings of this report are valid as of the report submittal date. However, changes in the conditions of the property can occur with the passage of time, whether they are due to natural processes or to the works of man, on this or adjacent properties. In addition, changes in applicable or appropriate standards occur whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this

report may be invalidated, wholly or partially, by changes outside our control. Therefore, information contained in the report should be re-evaluated after a period of three years to be consistent with existing conditions.

The interpretations and conclusion presented in this report are based on a study of inherently limited scope. Observations were qualitative, limited to surface expressions and limited natural and artificial exposures of subsurface materials. Interpretations of problematic hillslopes and erosion processes are typically based on the nature and distribution of existing features. For this reason, the conclusions should be considered limited in extent.

This report is issued with the understanding that it is the responsibility of the landowner, to ensure that the information and recommendations contained herein are reviewed and implemented according to the conditions at the time of construction. The conclusions and recommendations contained herein are professional opinions derived in accordance with current standards of professional practice. No other warranty expressed or implied is made.

## 3. BACKGROUND

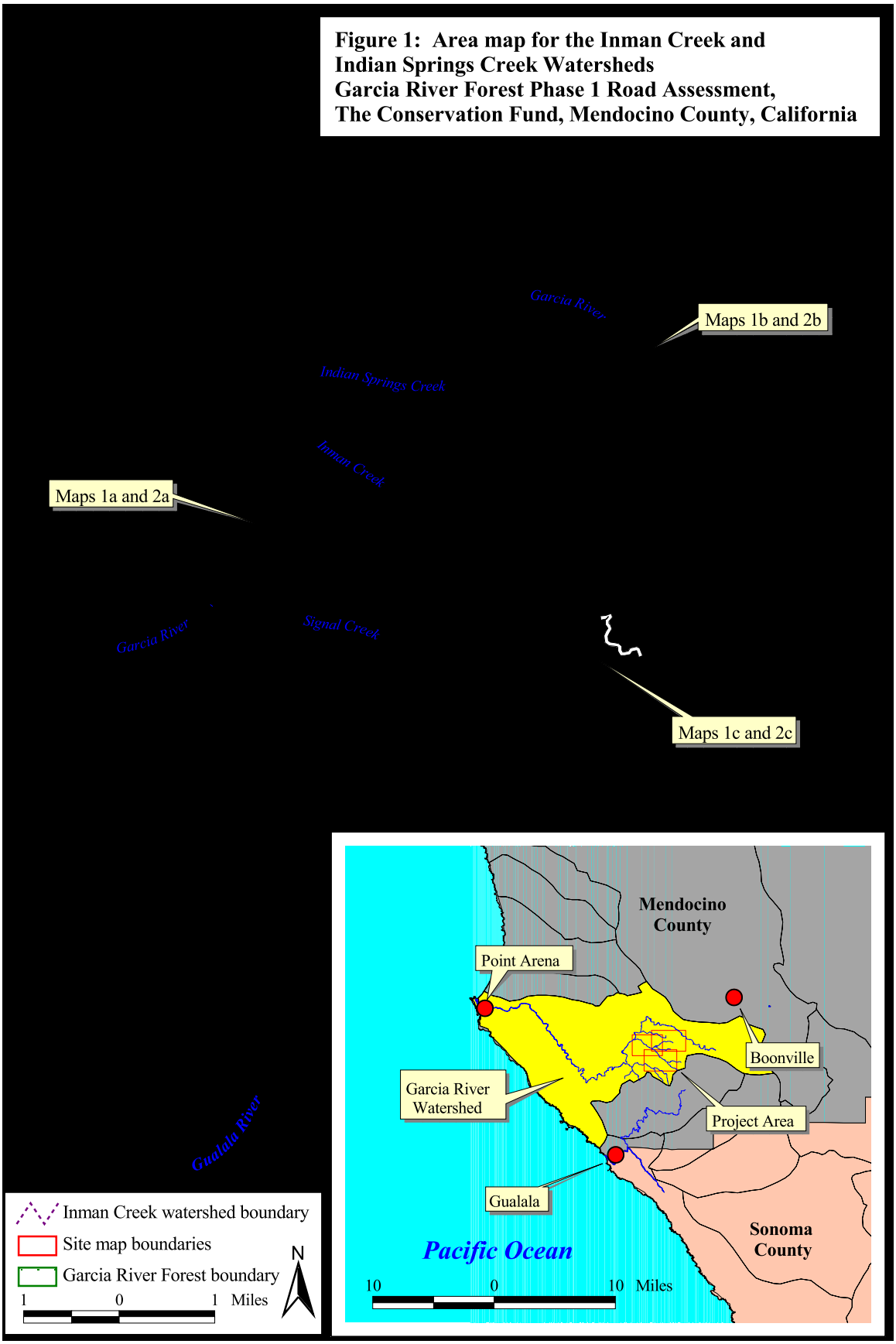
The Conservation Fund (TCF) has been an owner and manager of forestlands since 1995. Currently TCF has approximately 64,000 acres under active management in California, New York, Vermont and Virginia. In 2004, with the assistance of the State Coastal Conservancy, Wildlife Conservation Board and The Nature Conservancy, the largest addition to the TCF's timberland portfolio occurred with the purchase of the 24,000 acre "Garcia River Forest". The goal of the purchase was to provide a model demonstration project for sustainable forestry in the North Coast region.

The Garcia River Forest (GRF) is a prime example of coastal redwood forestland located in the middle portions of the Garcia River watershed, in southern Mendocino County. The GRF encompasses approximately 90% of the land area in the Signal, Inman, North Fork Garcia River and Olsen Gulch sub-watersheds. In addition, approximately 65% of the Graphite Creek and Indian Springs Creek sub-watershed and 35% of the Blue Waterhole Creek sub-watershed, along with numerous small unnamed sub-watersheds are included in the GRF (Figure 1). The highlight of the GRF property is the inclusion of 35 miles of fish-bearing streams that will provide critical refugia for the recovery of coho and fall chinook salmon, as well as steelhead trout within the North Coast region of California.

In 1994, the U.S. Environmental Protection Agency (EPA) listed the Garcia River watershed as impaired by excessive sediment. In 1997, the North Coast Regional Water Quality Control Board (NCRWQCB) undertook studies to determine the extent of the sedimentation impacts on aquatic habitat, the primary sediment production processes, how much was caused by human activities, how much was controllable, and to develop numeric targets for reducing sediment production from the various land-use practices occurring throughout the watershed. In 1998 and 1999, the NCRWQCB in cooperation with the EPA developed the "Total Maximum Daily Load" (TMDL) plan for the Garcia River basin (U.S. EPA, 1998), as well as the "Action Plan for the Garcia River Watershed Sediment TMDL", which is the TMDL implementation plan (NCRWQCB, 1999). The 1999 NCRWQCB Action Plan requires Garcia River landowners to develop either: 1) comprehensive ownership wide erosion control plans, or 2) comprehensive site specific erosion control plans, in order to meet the numeric targets established for sediment.

This report is a comprehensive site specific and prioritized erosion control plan for the Inman Creek watershed prepared by Pacific Watershed Associates, Inc. (PWA), intended to meet The Conservation

**Figure 1: Area map for the Inman Creek and Indian Springs Creek Watersheds Garcia River Forest Phase 1 Road Assessment, The Conservation Fund, Mendocino County, California**



Fund's TMDL submittal requirements to the NCRWQCB. TCF and PWA intend to begin implemented erosion control and erosion prevention activities along 12.8 miles of roads in the Inman Creek watershed this summer (2007).

## 4. SCOPE OF SERVICES

In May 2004, Chris Kelly, California Program Director, TCF, requested PWA to submit a watershed restoration and sediment assessment proposal to the California Department of Fish and Game (CDFG) Fisheries Restoration Grant Program. PWA proposed to conduct sediment source investigations and develop prioritized erosion control and erosion prevention plans throughout the Signal and Inman Creek sub-watersheds in the Garcia River basin. The proposal was accepted for funding, and PWA received a CDFG contract to perform the assessment in early 2006.

Between February and December 2006, PWA conducted an evaluation of site and erosional conditions along roads within the Inman Creek watershed. The work was performed under a CDFG grant (Contract #P0430414), as part of the Garcia River Forest Phase 1 Road Erosion Assessment, which includes both the Inman Creek and the Signal Creek watersheds. Approximately 64 miles of road was surveyed within the 8.6 $mi^2$ Inman Creek watershed. Specifically, PWA was requested to:

1) conduct a field assessment of potential and on-going surface runoff patterns and erosion risk associated with roughly 8 miles of the Inman Creek Road, a mainline timber haul road, and approximately 56 miles of secondary haul roads of varying construction dates, maintenance histories and condition,
2) develop a long-term, prioritized erosion control plan that includes recommended treatment prescriptions, typical construction drawings and cost estimates for controlling on-going and future erosion both along the surveyed roads, as well as on the adjacent hillslopes. The cost estimate will include all heavy equipment, labor, material and technical oversight costs to implement the recommended long-term erosion control measures, and
3) compile the field data and prepare final reports for submittal to CDFG, as well as the NCRWQCB to meet TMDL requirements.

The “erosion assessment protocol” developed by PWA, and approved by the California Department of Fish and Game, Regional Water Quality Control Board, Army Corp of Engineers, and the National Marine Fisheries Service, was employed to identify sites of existing and potential erosion, to develop treatment prescriptions and prepare this report (CDFG, 2002).

## 5. SITE CONDITIONS

The Inman Creek sub-watershed is located within the Garcia River watershed approximately 12 miles southeast of the town of Manchester and 9 miles southwest of the town of Boonville in Mendocino County (Figure 1). The Inman Creek Road is the main access road through the assessment area and can best be reached via the Graphite Road, which connects with Mountain View Road roughly 8.6 miles east of State Highway 1, or from the Fish Rock Road which intersects Highway 128 approximately 9 miles southeast of Booneville, California. The Inman Creek Road is a mainline timber haul road that is privately owned and gated at its intersections with Fish Rock Road at its eastern end and Hollow Tree Road at its western end (Figure 1). The PWA assessment began approximately 1 mile from the eastern end of Inman Creek Road at the Garcia River Forest boundary and continued to the gate at its western end, roughly 0.5 miles from its

intersection with Hollow Tree Road (Maps 1a to 1c). The assessment then continued onto the secondary haul roads within the watershed.

The southeastern 1.5 miles of the surveyed Inman Creek Road is in close proximity to the main stem class 1 Inman Creek. The mainline timber haul road then crosses the two forks of the North Fork Inman Creek but climbs away from the creek quickly. Except for Inman Creek Road, virtually all of the surveyed roads in the watershed have been abandoned for various time periods. The ridge roads, in general, can be traversed via ATV, while most of the lower roads in the watershed can only be accessed on foot. Dense whitethorn and manzanita bushes, young Douglas fir and redwood saplings, as well as "washed out or eroded" and formally decommissioned or "excavated" stream crossings prevent vehicle access. Some of these roads will need to be opened with heavy equipment before erosion control work can proceed

The Inman Creek assessment area contains Douglas fir and redwood forested hillslopes along north facing slopes within the lower two-thirds of the watershed, and oak, madrone and grassland hillslopes on the upper south facing slopes. The assessment area has been repeatedly logged since the late 1940's. The intense logging has greatly altered the hydrology of the area. Several springs and streams intersect the road, and many have been disturbed and filled with slash and past debris flow deposits.

The terrain ranges in steepness from 30% to near 70%. The hillslopes and the roads in the assessed area are underlain by mixed Franciscan Complex rock types and primarily by the soils of the Ornbaun-Zeni Complex. These soils are generally formed from weathered sandstone and have a low percentage of clay content in most locations. The moderately competent sandstone road surface along the Inman Creek Road has resulted in a native surface that is relatively stable, with a generally good driving surface. The mainline haul road is low gradient, averaging 3%-8% in steepness. The road bed is generally flat with periodic undulations changing the drainage runoff direction of the road. Several road segments show signs of surface flow, such as slight rilling, but minor road shaping will greatly improve surface drainage and stability.

## 6. ASSESSMENT RESULTS

There are 307 stream crossings located within the Inman Creek watershed assessment area (Table 1, Maps 1a to 1c), and 223 of these have been recommended for upgrading. An estimated 25,660 $yds^3$ of future sediment delivery can be saved over several decades by completing the suggested road upgrading or decommissioning at these stream crossings. Many culverts in the assessment area are short and installed high in the fill. This sharp decrease in the stream channel gradient associated with the low gradient and shallow culvert installation causes the stream channel to lose its carrying capacity for sediment and organics, and thus increases the plugging potential of the culvert. Along the abandoned or decommissioned roads in the Inman Creek watershed, the road fill at many of the stream crossings has been partially "excavated and removed." The heavy equipment operators excavated to a depth sufficient to pull out the culvert that had been installed, but frequently left some amount of the underlying fill remaining in the stream crossing. At many of these partial excavated stream crossings, PWA observed channel incision and down-cutting through the remaining road fill resulting in sediment delivery, as well as creating a channel through the road with unstable, vertical banks that are failing or have the potential to fail into the streams.

**Table 1. Site classification and sediment delivery from inventoried sites, Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California**

| Site Type | Number of sites or road miles | Number of sites or road miles to treat | Sites recommended for treatment | | | |
|---|---|---|---|---|---|---|
| | | | Future sediment delivery volume ($yds^3$) | Stream crossings w/ a diversion potential (#) | Streams currently diverted (#) | Stream culverts likely to plug (plug potential rating = high or moderate) |
| Stream crossings | 307 | 223 | 25,656 | 98 | 38 | 33 |
| Ditch relief culverts | 29 | 29 | 292 | NA | NA | NA |
| Landslides | 27 | 20 | 3,780 | NA | NA | NA |
| Other | 45 | 36 | 1,333 | NA | NA | NA |
| **Total (all sites)** | **408** | **308** | **31,061** | **98** | **38** | **33** |
| Persistent surface erosion[1] | 20.9 | 18.2 | 12,928 | NA | NA | NA |
| **Totals** | **20.9** | **18.2** | **43,989** | **98** | **38** | **33** |

[1] Calculated over a 10-year period. Assumes 25' wide road prism and cutbank contributing area, and 0.2' of road/cutbank surface lowering per decade on Inman Creek Road, and 0.1' per decade on all other roads.

Thirty-three (33) stream crossing culverts have a high to moderate plug potential rating (Table 1). In the event culvert inlets plug, 98 stream crossings have the potential to divert stream flow down the road and potentially cause significant gully erosion along the road bed and on the adjacent hillslopes (Table 1). A total of 38 streams in the assessment area are currently diverted out of their natural channel (Table 1). Many of these are located where the roads intersect small ephemeral streams, and many are resulting in continued gully erosion and sediment delivery to adjacent stream channels.

Table 2 provides a breakdown of stream crossing sites by the type of stream crossing drainage structure present, by the estimated future sediment delivery volume, by the erosion potential, and the number of each recommended for treatment. Stream crossings in the Inman Creek watershed can be divided into 6 types. They are:

(1) Decommissioned crossings: partial or completely excavated stream crossings,

(2) Fill crossings: earthen fill crossings generally located at small ephemeral streams where no formal drainage structure was installed to convey stream flow across the road,

(3) Culvert crossings: stream crossings with some type of pipe to convey flow,

(4) Ford or wet crossings: road crossings across generally larger streams where no fill had been placed in the stream to accommodate vehicular passage,

(5) Hunboldt log crossings: stream crossings consisting of varying amounts of large wood and logs placed in the stream channel and then buried with fill to accommodate vehicular passage, and

(6) Armored fill crossings: similar to fill crossings, but where there has been a formal effort to armor the fill slopes and road bed with coarse rip-rap to prevent erosion of the underlying fill material, instead of using a culvert.

There are 29 ditch relief culverts (DRC) that deliver road derived sediments to the watercourses within the assessed area (Table 1, Maps 1a to 1d). Each of these DRCs has been recommended for treatment. These culverts are also expected to deliver an estimated 300 $yds^3$ of eroded sediment caused by continued gully enlargement and destabilization of the native hillslopes below the culvert outlets. Much of this erosion can be alleviated by the installation of recommended road shaping treatments that will minimize the amount of road surface that drains to the DRCs.

**Table 2. Inventoried stream crossings by type, Inman Creek watershed assessment area**

| Stream crossing type | Number inventoried (#) | Number recommended for treatment (#) | Stream crossings recommended for treatment | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Future sediment delivery[1] ($yds^3$) | Erosion potential (#) | | | Diversion potential (#) | Currently diverted (#) |
| | | | | H/ HM | M/ ML | L | | |
| Decom-missioned | 140 | 76 | 4,471 | 11 | 38 | 27 | 14 | 4 |
| Fill | 97 | 84 | 8,872 | 31 | 40 | 13 | 47 | 29 |
| Culvert | 50 | 50 | 10,606 | 19 | 30 | 1 | 36 | 4 |
| Ford | 14 | 7 | 43 | 0 | 3 | 4 | 0 | 0 |
| Humboldt | 5 | 5 | 1,651 | 1 | 4 | 0 | 1 | 1 |
| Armored Fill | 1 | 1 | 13 | 0 | 0 | 1 | 0 | 0 |
| **Total** | **307** | **223** | **25,656** | **62** | **115** | **46** | **98** | **38** |

[1]Future sediment delivery does not include persistent surface erosion along hydrologically connected roads.

Only those landslide sites with a potential for sediment delivery to a stream channel were inventoried. A total of 27 landslides or potential fill failures were identified during the assessment. Of these, 20 were recommended for treatment. Most of the potential landslide sites were found along roads where material had been sidecast during earlier construction and now shows signs of instability. Potential landslides are expected to deliver approximately 3,800 $yds^3$ of sediment to Inman Creek and its tributaries in the future. Correcting or preventing potential landslides associated with the road is relatively straightforward. Stabilization efforts usually involve the physical excavation of potentially unstable road fill and sidecast materials and/or the application of road drainage treatments to the site to prevent road related runoff from draining onto the unstable area.

There are 45 sites that are listed in the "other" section of Table 1. These sites include 21 gully sites, 16 spring sites, 4 road surface erosion sites, and 4 bank erosion sites. Of these sites, PWA has recommended

treatment at 19 of the gully sites, 11 of the spring sites, 2 of the road surface erosion sites, and at all 4 of the bank erosion sites. It is estimated that these sites together will generate 1,340 $yd^3$ of future sediment delivery if they are not treated.

Currently, a total of 18.2 miles of road (28% of the total surveyed length) is hydrologically connected and delivers road bed derived runoff and sediment to streams. Applying a road surface lowering rate of 0.2 feet/decade to the length of hydrologically connected road on Inman Creek Road and 0.1 feet/decade on all other secondary roads, which have much less activity on them, we estimate the roads will deliver approximately 12,930 $yds^3$ of sediment to the nearby gullies and streams over the next decade if the surface drainage is not corrected. Thus, improving the road drainage design, as proposed, will prevent a total of approximately 44,000 $yds^3$ of future sediment delivery to streams over the next decade or so, as well as lessen future road maintenance requirements along the affected roads and provide for stable and safe year-around use.

In summary, improving the road drainage design and treating potential erosion sites, as proposed, could prevent a total of approximately 44,000 $yds^3$ of future sediment delivery to streams over several decades (Table 1), as well as lessen future road maintenance requirements along the affected roads and provide for stable and safe year-around use.

## 7. TREATMENT PRIORITY

This erosion assessment is intended to provide information to guide long-range transportation planning, as well as identify and prioritize erosion prevention and erosion control activities along the roads within the Inman Creek watershed assessment area. As a result, not all of the sites that have been recommended for treatment have the same priority. Treatment priorities are evaluated on the basis of several factors and conditions associated with each potential erosion site.

These include:

(1) the expected volume of sediment to be delivered to a stream;
(2) the potential for future erosion (high, moderate, low);
(3) the urgency of treating the site (treatment immediacy);
(4) the ease and cost of accessing the site for treatment; and
(5) the logistics and costs of recommended treatments.

Sediment delivery sites have been classified by number, type, treatment immediacy, and the total future erosion volume attributed to each treatment immediacy group (Table 3). The location of each site, according to treatment immediacy, is shown on Maps 2a to 2c.

**Table 3. Treatment priorities for inventoried sediment sources, Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California**

| Treatment Immediacy | Upgrade Sites (#) | Decommission sites (#) | Problem type | Future sediment delivery ($yds^3$) |
|---|---|---|---|---|
| High | 9 (sites 24, 30, 33, 43, 64, 73, 85, 173, 174) | 3 (sites 65, 114, 134) | 1 ditch relief culvert, 1 gully, 9 stream crossings, 1 other | 3,616 |
| High Moderate | 25 (sites 2, 14, 15, 21, 25, 26, 27, 32, 34, 39, 40, 44, 45, 49, 51, 53, 58, 71, 82, 83, 92, 96, 102, 148, 215) | 30 (sites 104, 110, 119, 137, 140, 144, 145, 146, 147, 175, 176, 178, 179, 182, 184, 188, 200, 210, 219, 221, 226, 230, 261, 293, 306, 346, 349, 350, 351, 352) | 1 ditch relief culvert, 3 gullies, 2 landslides, 46 stream crossings, 3 other | 12,425 |
| Moderate | 38 (sites 3, 4, 5.1, 8, 11, 12, 13, 16, 18, 19, 20, 23, 28, 29, 35, 42, 47, 52, 54, 56, 57, 59, 60, 66, 69, 72, 75, 77, 79, 93, 94, 97, 100, 101, 177, 216, 264, 265) | 38 (sites 111, 115, 118, 142, 161, 166, 168, 180, 181, 185, 187, 192, 195, 196, 204, 205, 209, 218, 222, 235, 238, 248, 267, 307, 314, 320, 329, 330, 341, 344, 353, 357, 362, 364, 369, 380, 395, 401) | 9 ditch relief culverts, 5 gullies, 7 landslides, 53 stream crossings, 2 other | 12,766 |
| Moderate Low | 34 (sites 5, 6, 7, 9, 10, 17, 22, 31, 36, 37, 41, 46, 48, 50, 55, 62, 63, 67, 68, 70, 74, 76, 78, 81, 84, 86, 88, 91, 95, 113, 124, 126, 169, 266) | 51 (sites 98, 107.1, 117, 123, 125, 131, 139, 143, 158, 171, 183, 186, 189, 191, 193, 194, 198, 199, 201, 202, 207, 208, 211, 217, 223, 224, 227, 234, 240, 242, 246, 247, 256.1, 258, 260, 273, 283, 289, 291, 303, 304, 319, 321, 322, 327, 333, 334, 338, 339, 372, 379) | 14 ditch relief culverts, 7 gullies, 3 landslides, 56 stream crossings, 5 other | 10,985 |
| Low | 14 (sites 1, 38, 80, 87, 89, 90, 97.1, 99, 103, 108, 109, 172, 262, 263) | 66 (sites 112, 116, 122, 132, 133, 136, 138, 141, 160, 163, 165, 167, 190, 197, 206, 213, 214, 225, 228, 231, 232, 233, 237, 239, 241, 250, 251, 252, 256, 259, 268, 269, 270, 272, 277, 278, 280, 285, 288, 292, 294, 296, 300, 301, 302, 328, 331, 332, 355, 356, 358, 361, 363, 366, 367, 368, 370, 374, 377, 381, 382, 383, 384, 391, 402) | 4 ditch relief culverts, 3 gullies, 8 landslides, 59 stream crossings, 6 other | 4,197 |

**Table 3. Treatment priorities for inventoried sediment sources, Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California**

| Treatment Immediacy | Upgrade Sites (#) | Decommission sites (#) | Problem type | Future sediment delivery ($yds^3$) |
|---|---|---|---|---|
| **Total** | **120** | **188** | **29 ditch relief culverts, 19 gullies, 20 landslides, 223 stream crossings, 17 other** | **43,989** |

## 8. EROSION CONTROL PLAN

The general types of recommended corrective measures along the assessed roads in Inman creek are displayed in Table 4. Individual data forms for each of the 408 mapped sites of potential sediment delivery have been compiled in an Access database. The detailed treatments at each site are described on the data forms and in the database. Typical construction drawings for each type of treatment are shown in Appendix A.

A total of 52 critical rolling dips have been recommended to prevent future diversions at stream crossings that currently have a diversion potential. The installation of 19 culverts has been recommended at locations where no culvert is currently installed. The replacement of 34 undersized and deteriorating stream crossing culverts is recommended to upgrade the sites to accommodate the 100 year discharge calculation and eliminate on-going erosion.

Four (4) armored fills have been prescribed requiring 90 $yds^3$ of clean rip-rap. Downspouts have been recommended to protect the fillslope below 8 stream crossing and 8 ditch relief culverts. A trash rack will be installed to lower the risk of culvert plugging at 12 stream crossing locations. In addition, a total of 464 $yds^3$ of mixed diameter and clean rip-rap sized rock will be required for the armoring of 33 fill faces. Approximately 178 $yds^3$ of road rock is required to surface the road at 10 locations.

We have prescribed converting insloped, flat or crowned road shapes to 3%-4% outsloped road shapes with no inboard ditch to better disperse road surface runoff at 71 road reaches totaling 33,250 feet in length. Outsloping the road while retaining the inboard ditch to convey emergent cutbank flow to a drainage structure is prescribed for 33 road reaches totaling 8,065 feet. The cleaning or cutting of the inboard ditch is prescribed at 7 locations totaling 475 feet of ditch. We have recommended the installation or replacement of a total of 57 ditch relief culverts to disconnect inboard ditches from stream crossings and hillslope gullies. Also recommended is the construction of 231 rolling dips at selected locations at spacings dictated by the steepness of the road. On roads to be decommissioned, 434 cross road drains have been prescribed to ensure maintenance free drainage. Once the road shaping and road drainage structures have been constructed, sections of the road that were previously rocked should be re-rocked with 1.5 inch diameter, relatively clean rock to a depth of 3" to 4".

**Table 4. Recommended treatments along all inventoried roads, Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California**

| Treatment | No. | Comment |
|---|---|---|
| Critical dip | 52 | To prevent stream diversions |
| Install CMP[1] | 19 | Install a CMP at an unculverted fill |
| Replace CMP[1] | 34 | Upgrade an undersized CMP |
| Wet crossing | 4 | Install rocked ford and armored fill crossings using 90 $yds^3$ of rip-rap |
| Install downspout[1] | 16 | Installed to protect the outlet fillslope from erosion at 8 DRCs and 8 stream crossings |
| Clean and/or repair CMP | 1 | Remove debris and/or sediment from CMP inlet |
| Install trash rack | 12 | Install trash rack to protect culvert inlet from plugging |
| Armor fill face | 33 | Armor outboard fill face using 464 $yds^3$ of rip-rap |
| Excavate soil | 183 | Typically fillslope & crossing excavations; excavate a total of 38,253 $yds^3$ |
| Outslope road and remove ditch | 71 | Outslope and remove ditch along 33,250 feet of road to improve road surface drainage |
| Outslope road and retain ditch | 33 | Outslope and retain ditch along 8,065 feet of road to improve road surface drainage |
| Clean or cut ditch | 7 | Clean or cut 475 feet of ditch |
| Install ditch relief culverts[1] | 57 | Install ditch relief culverts to improve road surface drainage |
| Install rolling dips | 231 | Install rolling dips to improve road drainage |
| Install cross road drains | 434 | Install cross road drains to improve road drainage |
| Rock road surface | 10 | Rock road surface using 178 $yds^3$ of rock at 4 rolling dips, 1 critical dip, 2 road outsloping locations, 2 DRCs and 1 site specific location. |
| Engineered Fill | 1 | Engineer designed retaining wall is required at landslide site #71. |
| Other | 1 | Miscellaneous treatment |

[1] Culvert installation/replacements, downspout and ditch relief installations require placement of the following culvert sizes and lengths including couplers, where prescribed: 1,980' of 18", 2,670' of 24", 890' of 30", 150' of 36", 100' of 48", 90' of 60", 80' of 72"

## 9. EQUIPMENT NEEDS

Equipment needs for work at all sites with future sediment delivery are detailed in the project database and summarized in Table 5 as equipment times, in hours, to treat all sites and hydrologically connected road reaches identified in the assessment. These estimates include only the time needed to treat each of the sites, and do not include travel time between work sites, or the time needed for work conferences at each site. These additional times are accumulated as "logistics" and have been added to the work times to determine total equipment costs as shown in Table 6.

Recommended treatments for the 308 sites in the Inman Creek watershed assessment area will require approximately 1,448 hours of excavator time and 1,717 hours of bulldozer time for completion of all prescribed upgrading, erosion control and erosion prevention work (Table 5). Excavator and dozer work is not needed at all the sites that have been recommended for treatment, and likewise, not all the sites will require both a dozer and an excavator.

Approximately 263 hours of water truck time will be needed for application of water to dry soils during road drainage treatment implementation and for backfilling of stream crossing and ditch relief culvert excavations. For the transportation of spoil material between sites, 250 hours of dump truck time will be required. Ninety-five (95) hours of grader time will be required to complete the road shaping prescribed in the assessment. Finally, approximately 496 hours of labor time are needed for a variety of tasks such as installation or replacement of culverts (Table 5).

**Table 5. Estimated heavy equipment and labor requirements for treatment of all inventoried road sites with future sediment delivery, Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California [1]**

| Treatment Immediacy | Site (#) | Excavated Volume ($yds^3$) | Excavator (hrs) | Dozer (hrs) | Dump Truck (hrs) | Grader (hrs) | Water truck (hrs) | Labor (hrs) |
|---|---|---|---|---|---|---|---|---|
| High, High/Moderate | 67 | 21,604 | 631 | 688 | 186 | 28 | 108 | 211 |
| Moderate, Low/Moderate | 161 | 23,741 | 684 | 860 | 56 | 58 | 138 | 250 |
| Low | 80 | 5,012 | 133 | 169 | 8 | 9 | 16 | 35 |
| **Total** | **308** | **50,357** | **1,448** | **1,717** | **250** | **95** | **263** | **496** |

[1] Equipment and labor times do not include hours necessary for road opening, travel between sites, and straw mulch activities.

## 10. COST ESTIMATE

Table 6 summarizes all costs to implement the recommended erosion control treatments along the surveyed roads within the assessment area. The cost estimate is separated into 4 parts: 1) the total heavy equipment and laborer costs, including equipment move-in and move-out costs, to treat the 64 miles of road in the Inman Creek watershed assessment area, 2) the costs for materials to complete the project; primarily culverts, rip-rap and road rock, 3) the costs for PWA to provide technical guidance of the work, and 4) a determination of the project cost-effectiveness by dividing the total cost estimate by the estimated potential sediment savings. We estimate approximately $1,115,850 is needed to complete all the on-the-ground work to storm-proof along 8 miles of the Inman Creek Road and 56 miles of the secondary timber haul roads. This equates to an estimated cost effectiveness of $26.08 per cubic yard of sediment saved within the Inman Creek assessment area.

**Table 6. Total estimated equipment and labor times, logistic requirements and costs for road-related erosion control and erosion prevention work on all inventoried sites with future sediment delivery in the Inman Creek watershed, Garcia River Forest Road Erosion Assessment Phase 1, Mendocino County, California** [1]

| Cost Category[1] | | Cost Rate[2] ($/hr) | Estimated Project Times | | | Total Estimated Costs[5] ($) |
|---|---|---|---|---|---|---|
| | | | Treatment[3] (hours) | Logistics[4] (hours) | Total (hours) | |
| Move-in; move-out[6] | Excavator | 100 | 6 | -- | 6 | 600 |
| | Dozer | 100 | 6 | -- | 6 | 600 |
| | Grader | 100 | 6 | --- | 6 | 600 |
| | Water Truck | 100 | 6 | -- | 6 | 600 |
| Road opening costs | Excavator | 125 | 25 | -- | 25 | 3125 |
| | Dozer | 95 | 40 | -- | 40 | 3800 |
| Heavy equipment requirements for site specific treatments[7] | Excavator | 125 | 1,307 | 392 | 1,699 | 212,375 |
| | Dozer | 95 | 1,260 | 378 | 1,638 | 155,610 |
| | Dump truck | 85 | 270 | 81 | 351 | 29835 |
| | Water truck | 85 | 136 | 41 | 177 | 15045 |
| Heavy equipment requirements for road drainage treatments[8] | Excavator | 125 | 171 | 52 | 223 | 27,875 |
| | Dozer | 95 | 457 | 138 | 595 | 56,525 |
| | Water truck | 85 | 147 | 44 | 191 | 16,235 |
| | Grader | 95 | 115 | 35 | 150 | 14250 |
| Laborers[9] | | 45 | 938 | 281 | 1219 | 54855 |
| Rock costs (includes trucking for 178 yds$^3$ of road rock and 554 yds$^3$ of rip-rap) | | | | | | 13171 |
| Culvert materials costs (1,980' of 18", 2,670' of 24", 890' of 30", 150' of 36", 100' of 48", 90' of 60", and 80' of 72", including costs for couplers) | | | | | | 126126 |
| Mulch, seed and planting materials for 27.62 acres of disturbed ground[10] | | | | | | 15,188 |
| Layout, coordination, supervision, and reporting[11] | | | | | | 182,280 |
| **Total Estimated Costs** | | | | | | **$ 928,695** |
| **Potential sediment savings: 43,989 yds$^3$** | | | | | | |
| **Overall project cost-effectiveness: $21.11 spent per cubic yard of sediment saved** | | | | | | |

[1] Costs for tools and miscellaneous materials have not been included in this table. Costs for administration and contracting are variable and have not been included. Costs to re-pave upgrade sites are not included.
[2] Costs listed for heavy equipment include operator and fuel. Costs listed are estimates for favorable local private sector equipment rental and labor rates.
[3] Treatment times include all equipment hours expended on work directly associated with erosion prevention and erosion control at all sites.
[4] Logistic times for heavy equipment (30%) include all equipment hours expended for opening access to sites on maintained and abandoned roads, travel time for equipment to move from site to site, and conference times with equipment operators to convey treatment prescriptions and strategies. Logistic times for laborers (30%) include estimated daily travel time to project area.
[5] Total estimated project costs for equipment rental and labor are based on private sector rates at prevailing wage. Materials costs are subject to change.
[6] Lowboy hauling costs area based on two hauls each (one to move in and one to move out) at six hours per round trip for excavator, dozer, grader, and water truck.
[7] An additional 20 hours of dump truck time and 30 hours of excavator time have been added for culvert and straw distribution.
[8] An additional 20 hours of water truck time and 20 hours of grader time have been added for final grading and spreading of road rock.
[9] An additional 442 hours of labor time have been added for straw mulch and seeding activities.
[10] Seed costs are based on $50 per pound for native seed, at 20 pounds of native seed per acre. Straw costs include 50 bales per acre at $5 per bale. Sixteen hours of labor are required per acre of mulching and seeding.
[11] Supervision time includes detailed layout (flagging, etc) prior to equipment arrival, training of equipment operators, supervision during equipment operations, supervision of labor work and post-project documentation and reporting.

## 11. REFERENCES

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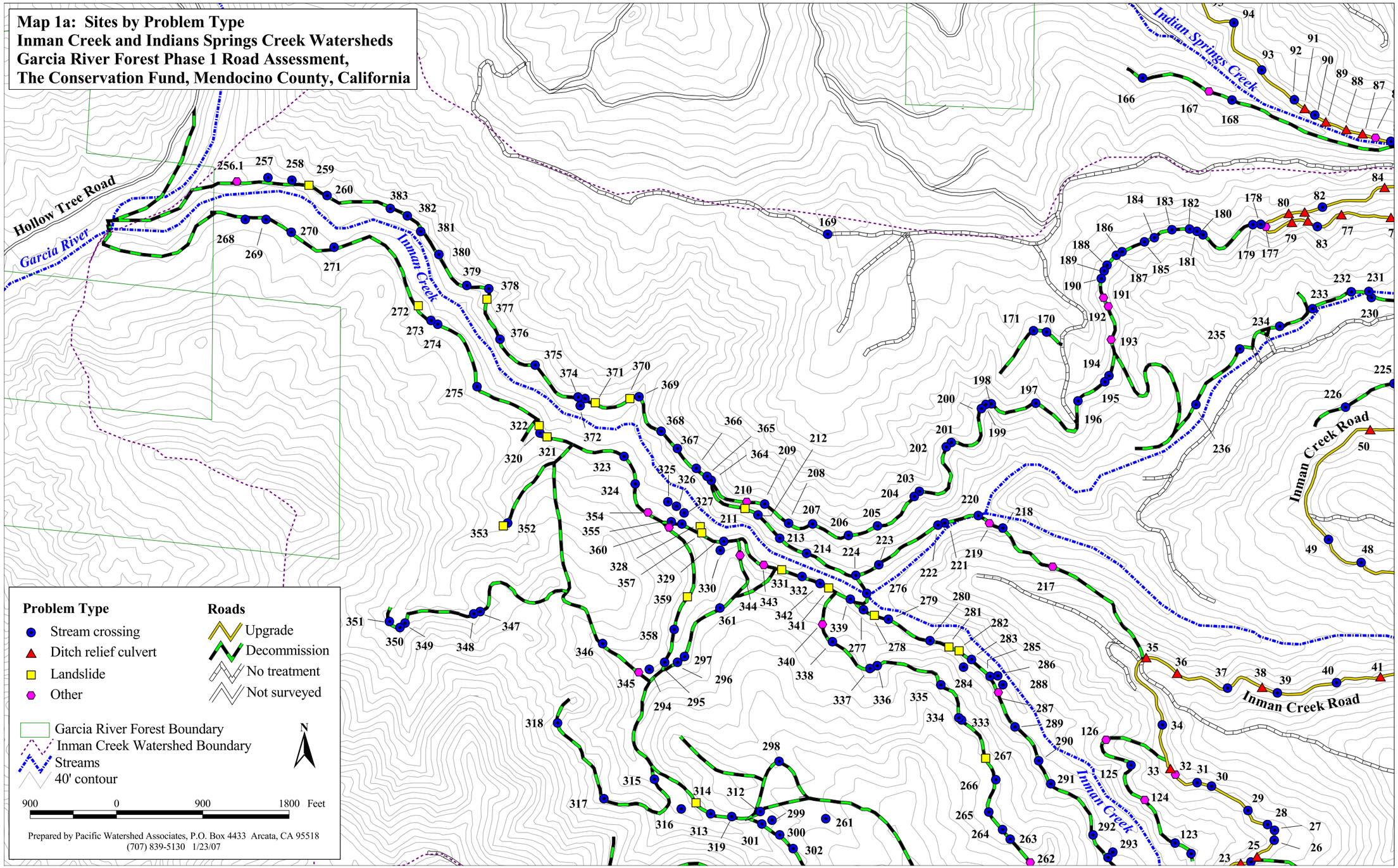
North Coast Regional Water Quality Control Board, 2001, The Action Plan for the Garcia River Watershed Sediment TMDL: Santa Rosa, CA, 541 p. Available from: http://www.swrcb.ca.gov/rwqcb1/programs/tmdl/garcia/docs/GarciaActionPlan.doc

**Map 1a: Sites by Problem Type**
**Inman Creek and Indians Springs Creek Watersheds**
**Garcia River Forest Phase 1 Road Assessment,**
**The Conservation Fund, Mendocino County, California**

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**Map 1b: Sites by Problem Type**
**Inman Creek and Indians Springs Creek Watersheds**
**Garcia River Forest Phase 1 Road Assessment,**
**The Conservation Fund, Mendocino County, California**

Inman Creek Road
Hollow Tree Road
Indian Springs Creek
Phelps
Hollow Tree Road
Garcia River
Ridge
Inman Creek Road
Inman Creek Road

**Problem Type**
- Stream crossing
- Ditch relief culvert
- Landslide
- Other

**Roads**
- Upgrade
- Decommission
- No treatment
- Not surveyed

Garcia River Forest Boundary
Inman Creek Watershed Boundary
Streams
40' contour

N

900 0 900 1800 Feet

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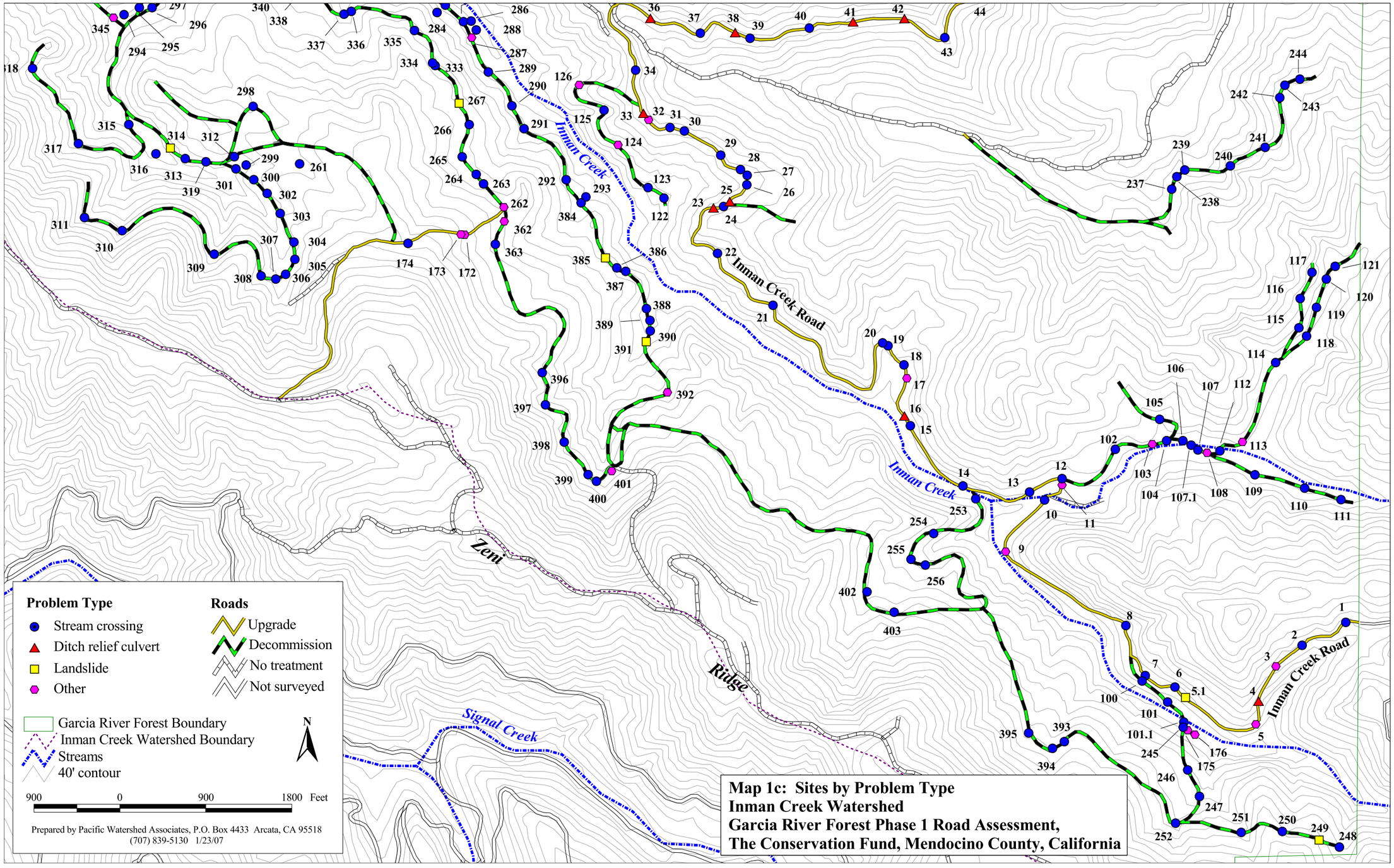
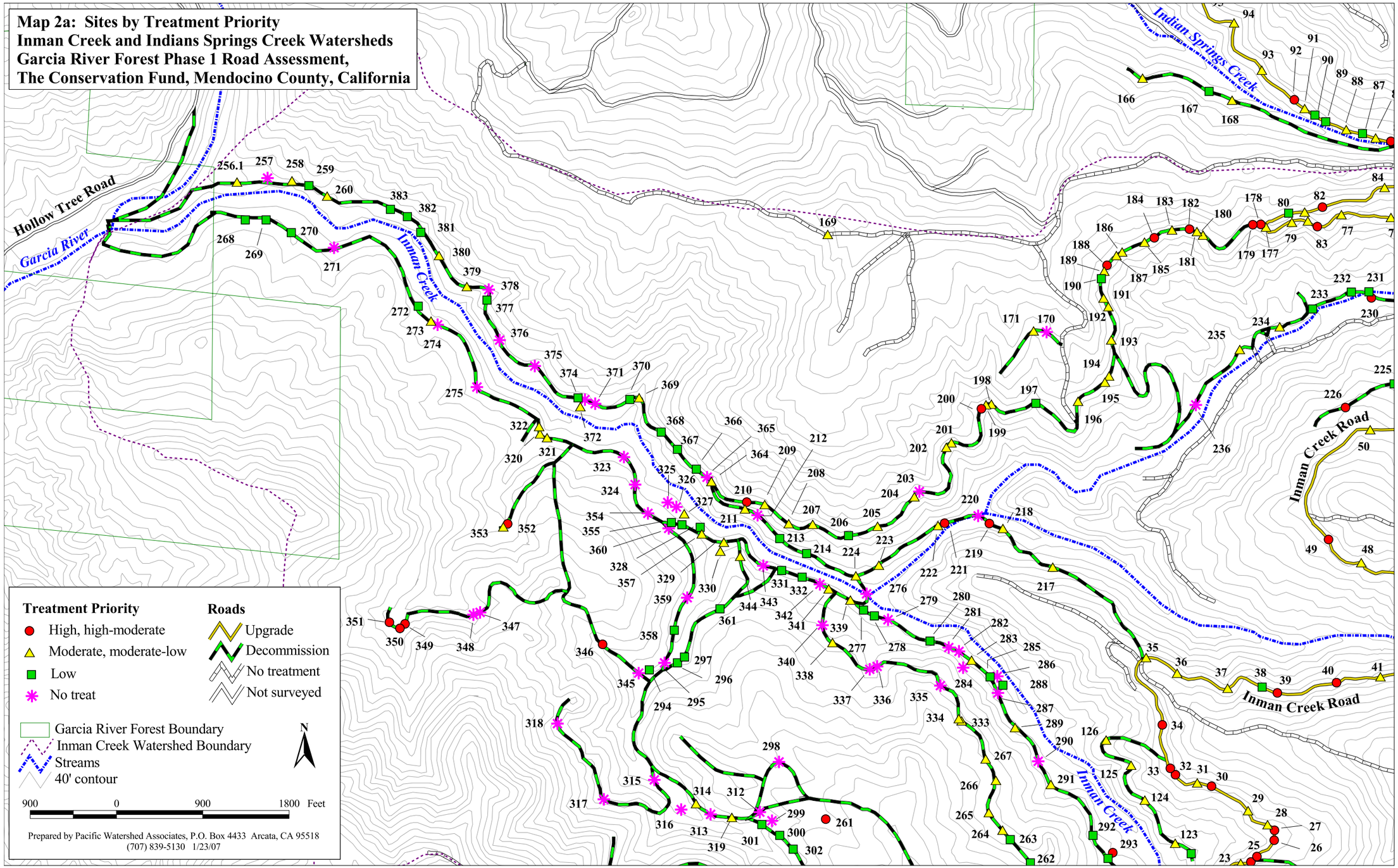

Inman Creek
Inman Creek Road
Zeni Ridge
Signal Creek
Problem Type
Stream crossing
Ditch relief culvert
Landslide
Other
Roads
Upgrade
Decommission
No treatment
Not surveyed
Garcia River Forest Boundary
Inman Creek Watershed Boundary
Streams
40' contour
N
900 0 900 1800 Feet
Prepared by Pacific Watershed Associates, P.O. Box 4433 Arcata, CA 95518
(707) 839-5130 1/23/07
Map 1c: Sites by Problem Type
Inman Creek Watershed
Garcia River Forest Phase 1 Road Assessment,
The Conservation Fund, Mendocino County, California

**Map 2a: Sites by Treatment Priority**
**Inman Creek and Indians Springs Creek Watersheds**
**Garcia River Forest Phase 1 Road Assessment,**
**The Conservation Fund, Mendocino County, California**



**Map 2b: Sites by Treatment Priority**
**Inman Creek and Indians Springs Creek Watersheds**
**Garcia River Forest Phase 1 Road Assessment,**
**The Conservation Fund, Mendocino County, California**

Inman Creek Road
Hollow Tree Road
Indian Springs Creek
Phelps
Hollow Tree Road
Garcia River
Ridge
Inman Creek Road
Inman Creek Road

**Treatment Priority**
- High, high-moderate
- Moderate, moderate-low
- Low
- No treat

**Roads**
- Upgrade
- Decommission
- No treatment
- Not surveyed

Garcia River Forest Boundary
Inman Creek Watershed Boundary
Streams
40' contour

N

900 0 900 1800 Feet

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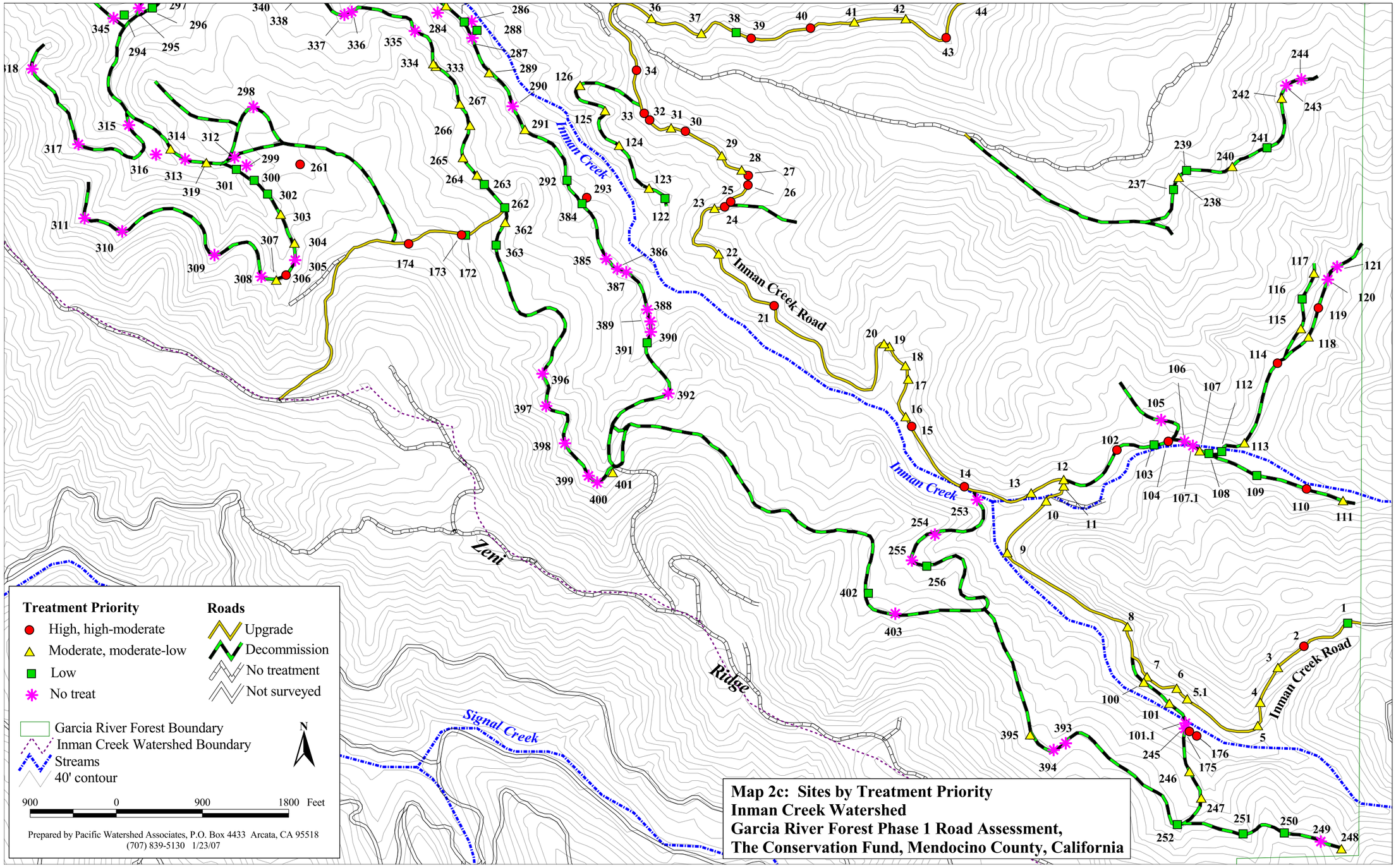
(707) 839-5130 1/23/07




**Map 2c: Sites by Treatment Priority**
**Inman Creek Watershed**
**Garcia River Forest Phase 1 Road Assessment,**
**The Conservation Fund, Mendocino County, California**

# Appendix A.

## Summary of Site Conditions

### at all 408 Mapped Sites with Potential Sediment Delivery within the Inman Creek watershed, Garcia River Forest Phase 1 Road Erosion Assessment, Mendocino County, California.

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 1 | Stream crossing | 2 x 1 class 3 ephemeral stream drained by a 24" CMP. Culvert is not at grade, but is in no danger of washing out. 1046' of road drainage with ditch feeds to inlet from left. One DRC is needed to convey flows from short length of wet ditch. | M | 1046 | 0 | 68 | L | 1. Attach 40' of 24" DS to existing CMP.<br>2. Outslope 996' of left approach at 4-5% and remove ditch.<br>3. Outslope and keep ditch for 50' up left (4-5%).<br>4. Install 1 DRC at upper end of slump.<br>5. Install 10 rolling dips to left. |
| 2 | Stream crossing | An undersized 15" CMP has been installed at a small 2'x0.5' class 3 stream. Pipe outlet is set far to right of CLP. A 20'Wx4'Dx18'L hole has been created at OBF at outlet. A 20' long half-round downspout now hangs in mid-air with a 7' drop to ground. Most erosion at this hole has ceased since downspout installation but a deep hole below downspout may continue to threaten fill. | M | 825 | 0 | 46 | HM | 1. Replace existing pipe with a 24"x 40’ set in notch. Move pipe outlet ~25' to left of current outlet so it is in line with channel.<br>2. Install a 24"x20' downspout<br>3. Install a CD to right hinge<br>4. OSR - RB+FD 825' left<br>5. Install 5 RDs left<br>6. Armor steep OBF with 7 cubic yards 1' 0 rip-rap |
| 3 | Gully | 340 feet of 11% road with ditch and berm (3'x5'x150') exit road surface via small dip, resulting in a 3'x2'x175' gully, connected to Inman Creek. | M | 340 | 0 | 6 | M | 1. Outslope and remove ditch.<br>2. Remove berm (5X3X150).<br>3. Install rolling dips.<br>4. Install 1 DRC to transmit flows for swale. |
| 4 | Ditch relief culvert | A 24" DRC receives 575' of IBD. A 10'Wx3'Dx20'L hole has been created in OBF at outlet. Flow then crosses an old road bed where a 3'x3'x35' gully cuts into OBF. Another 3X3X40 gully runs to creek below. Future erosion is from road lowering and 100% gully enlargement. | HM | 575 | 0 | 27 | M | 1. OSR-PB+FD 575' left.<br>2. Install 3 rolling dips to left. |
| 5 | Gully | 247 feet of insloped road drains off road at small dip 3x3x225 connects road to stream. Future based on gully expanding to 3x4x225. Cutbanks are dry. All ditches to be removed. | ML | 247 | 0 | 25 | ML | 1. Outslope and remove ditch for 247 feet up left. Outslope 4%-5%.<br>2. Install 2 rolling dips up left. |
| 5.1 | Landslide | New section calving off of old landslide. New slide exhibits 6" cracks with 1' displacement. Slide material will mostly be caught on lobe of material from previous slide. See sketch. Road width is 12' here with room to cut 2' into cutbank. Spoil storage available locally. | HM | 0 | 0 | 18 | M | 1. Excavate 89 yd3 of material and store 50' to the right or left of site. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 6 | Stream crossing | A 2x1 class 3 flows down a steep swale and into a 24" CMP. Pipe is set shallow in fill but is functioning. Slightly shot gunned. Outlet drops flow onto very stable redwood cluster. Pipe install is OK. There is a diversion potential to right. | ML | 290 | 0 | 187 | ML | 1. Install CD to right hinge.<br>2. OSR-PB-FD 290 left.<br>3. Install 1 road left. |
| 7 | Stream crossing | 2x1 class 3 ephemeral with an undersized 16" CMP. Culvert is shallow (10%) and placed out of CLP. Inlet also drains spring site in right ditch. 178' of low-gradient left approach and 283 feet of low gradient right approach connected. | M | 178 | 283 | 151 | ML | 1. Excavate crossing from top to bottom and install 24" CMP in axis at base of fill (move outlet approximately 10' left).<br>2. Clean/cut ditch 65' right.<br>3. OSR and FD 178' left.<br>4. OSR and KD 65' right.<br>5. OSR and FD 218 right.<br>6. Install 3 rolling dips (1 left) (2 right).<br>7. Armor bottom 1/4 OBF with 5yd3 .5-1.5 rock. |
| 8 | Stream crossing | A 24" CMP drains a 3x1 class 3. Pipe is set very shallow in fill and outlet has been placed ~10' to right of CLP. A (9'Wx2'Dx10'L) hole has been cut into OBF. A large berm has been built across inlet to add headwall but road has DP to right. | M | 215 | 0 | 138 | M | 1. Replace pipe with 24" x (50) in CLP of channel and at grade with stream. Try to save existing pipe.<br>2. Install a critical dip to right hinge.<br>3. OSR - PB + FD across turnout to left.<br>4. Install one rolling dip to left.<br>5. Armor steep OBF with 17 cubic yards rip-rap, 1' diameter. |
| 9 | Gully | 1,675' of road is poorly drained with sporadic erosion. Future erosion based on gully expansion at bottom of road segment. Two small spring sites on approach. | ML | 1675 | 0 | 2 | ML | 1. Outslope 1575' of left and fill ditch.<br>2. Outslope 100' of left and keep ditch around springs.<br>3. Install two DRCs at spring sites.<br>4. Install 11 rolling dip up road to left. |
| 10 | Stream crossing | Ford crossing at 16x2 class 1 stream. Left approach is short with little contribution. Right approach (233') needs to be drained. There is also a stream that may be diverted that also flows to this site (see sketch). Diverted stream should be addressed by Tmt site #11. No fill in ford and it functions well. | ML | 85 | 233 | | ML | Install two rolling dips to right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 11 | Gully | Two skid roads intersect Inman Creek Road at this spot. 450' from lower left road and 325' of upper right road contribute to this site. Drainage flows across Inman Road and creates a 6'W x 3'D x 18'L gully to a class 3 creek below. This gully will continue to headcut across road. Future erosion is estimated from headcutting. | H | 450 | 325 | 10 | M | 1. Rip roads above Inman and install 8 XRDs (4 on each side). |
| 12 | Stream crossing | A 4x1 class 2 stream flows through a potentially undersized 24" CMP. Pipe is set shallow in fill. A trash rack post has been installed flush against the inlet. An active spring emerges from cutbank at right hinge line and is beginning to cut into OBF after flowing across road. A 3x3x12 gully already exists and will continue to cut across road.<br>5/5/06- CMP size has been check and is OK. | M | 0 | 90 | 6 | M | 1. Install a critical dip to left hinge.<br>2. Armor OBF with 2cy of 1' diameter rip rap to protect from spring flow. |
| 13 | Stream crossing | Small 2'x.5' class 3 stream has developed sediment fan above road. Redwood stump in middle of fan has split flows and caused stream to deposit two small fans on the road bed. Flat road here influences road to pond up in this location and erode 5x3x50, 28yd3 gully to left of natural channel (see sketch). Low gradient approaches deliver little sediment but contribute additional flow to this site. Broad armored dip here would serve well. | ML | 447 | 154 | 15 | M | 1. Dip out road and install armored fill with 15yd3 of 1/2'-1' rock.<br>2. OSR - FD 447' to the left and 154 to the right.<br>3. Add three rolling dips to the left and one to the right. |
| 14 | Stream crossing | An oddly located 3x1 class 3 stream cascades down a steep bedrock swale and hits road fill. Flow diverts to left for ~300' to low spot in road. A cutbank failure to left of stream was likely triggered by it. A small road bench exists below road where we would like to get flow. Fill on the lower road bench will need to be pulled. Pipe installation here would be difficult due to the likelihood of pipe plugging. | HM | 0 | 340 | 60 | HM | 1. Pull back fill from OBR to BOT and lay back to 2:1 spoil ~100 cubic yards on flat at low spot 200' to left.<br>2. Dip out crossing and install armored fill using (50) cubic yards of rip-rap.<br>3. Excavate 20 cubic yards from unstable banks to right of BOT.<br>4. OSR - FD 340' right.<br>5. Install two rolling dips right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 15 | Stream crossing | A rowdy and steep class 2 stream estimated at a 5x1 (difficult to estimate due to braided channel through earthflow covered with ferns and whitethorn). Flows enter IBD and divert 90' to the right to newly installed 15" aluminum pipe. Pipe has a 10' long half-round downspout that is hanging almost straight down and is not helping. Pipe shotguns 12' onto stream terrace and beginning to erode. Stream flows exceed ditch and flow 90' down road prism to drain on top of pipe. Old road below the site should be excavated to connect stream with natural channel. | HM | 270 | 0 | 112 | HM | 1. Excavate TOP to BOT. Install a 24" x 80' CMP in axis of channel and at grade.<br>2. Construct a critical dip on right hinge.<br>3. OSR-FD 270' left approach.<br>4. Construct 2 rolling dips on left approach. |
| 16 | Ditch relief culvert | This pipe is now acting as the class 3 stream crossing culvert from site #15. The stream diversion will cease with the treatment of #15. Pipe inlet has been ripped and pinched by cleaning. The pipe is shotgunned 10' with an almost vertical 1/2 round downspout at outlet. This site will be OK when site #15 is treated. Crossing future erosion has already been attributed to #15. | HM | 120 | 180 | 1 | M | 1. OSR - FD 120' left and 180' right.<br>2. Install one rolling dip left and one right. |
| 17 | Spring | A very active spring runs down cutbank and onto roadbed. Flow travels 108' to left and exits road at thru-cut. A stable channel has been established at exit. Flow could begin to cut into road bed, however. Future erosion is from spring flow incising road bed. Hillslope across from spring is low gradient and stable. | ML | 0 | 104 | 4 | ML | 1. Pull back some of the berm to left of spring at OBF and use it to create a large dip to get spring flow directly across road. No armor is necessary. |
| 18 | Stream crossing | 24" aluminum CMP with mangled inlet drains 3'x1' class 2 stream. Sediment aggraded above inlet. Single post trash rack installed against inlet causing it to plug. Pipe shotguns 2' at outlet. DP to left into a dip that cuts its own gully out across terrace. 297' of road/ditch delivers from right approach. Pipe does not need to be as long as this one if properly installed. | M | 0 | 297 | 77 | M | 1. Excavate top to bottom. Replace with 24" X (70') CMP in axis at grade.<br>2. Install critical dip to left hinge.<br>3. Outslope - FD lower 100' of right approach.<br>4. Add two rolling dips to right approach. |
| 19 | Stream crossing | An 8'x1.5' class 2 stream flows through a potentially undersized 48" CMP. Pipe is set slightly shallow in fill. A half-round 10' downspout gets flow from pipe outlet to BOT. Although pipe is short and set shallow, it is functioning well and is OK if sized appropriately. A 2' diameter brow log to right of inlet protects IBF. There is diversion potential to left. 5/5/06- CMP is sized well. | ML | 0 | 96 | 0 | M | 1. Install a critical dip to left hinge. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 20 | Stream crossing | Tiny, steep 2x.5 class 3 stream is drained by fill crossing. Flows have cut 15x2x10 = 11 yd3 PE. Gully in OBF. Mild DP to the left. 1976' of right approach delivers to site. Install armored fill crossing. | M | 0 | 1976 | 18 | M | 1. Dip out 37 yd3 from RD surface. Install armored fill crossing using 15 yd3 of .5-1.5' rock.<br>2. OSR - FD 1976' to the right.<br>3. Install 13 rolling dips on the right approach. |
| 21 | Stream crossing | A 3x1 class 3 stream cascades down a steep swale and enters an undersized 15" CMP. Pipe outlet is set ~5' to left of CLP. Pipe is short and installed extremely shallow. An old sediment deposit exists across swale above inlet and small swale to right. 50' wide area below swales is springy. Pipe has outcropped before and had exited road bead 25' to left of CLP but made it back into notch. There is DP to left. | HM | 0 | 810 | 217 | HM | 1. Replace existing pipe with a 24" X 70' CMP.<br>2. Armor OBF with 20 cubic yards rip-rap.<br>3. Install trash rack to inlet.<br>4. Install critical dip to left hinge.<br>5. Cut ditch for 50' to right of inlet across swales.<br>6. OSR - FD 810' right.<br>7. Install four rolling dips right. |
| 22 | Stream crossing | Small, steep class 3 stream with broad fan above road is drained by a fill crossing. Flows across road have cut a 3x2x30' 7 yd gully down OBF. No DP here. | ML | 65 | 926 | 148 | ML | 1. Excavate top to bottom. Install 24" x (60') CMP in axis at grade.<br>2. OSR - FD 926' up right approach.<br>3. Install six rolling dips to the right.<br>4. Armor entire steep fill face with 16 cubic yards of rip-rap. |
| 23 | Ditch relief culvert | A 15" rusted DRC drains 230' of very active IBD. Pipe also receives some diversion flow from pipe of site #24. A 7'Wx7'Lx4'D hole exists at OBF from shotgunned outlet and from water exiting bottom of rusted pipe. Future erosion is estimated from 10'Wx10'Lx1'D chunk of OBF failing around pipe outlet. | HM | 150 | 80 | 4 | M | 1. Replace DRC with 18" X 30'.<br>2. OSR - KD 150' to the left and 80' to the right. |
| 24 | Stream crossing | 3X1 class 2 stream drained partially by a 15" aluminum pipe. Channel above road highly disturbed by tractoring, and wanders hither and yon about on the hillside. It is currently flowing down the hillside downhill of the inlet (see sketch). Most flows now divert down ditch to site #23. This whole area is very springy and very heavily roaded. | H | 0 | 100 | 62 | H | 1. Excavate top to bottom. Replace with 24" X (60') CMP in axis at grade.<br>2. Add critical dip to left hinge.<br>3. OSR - FD 100' to the right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 25 | Ditch relief culvert | An 18" DRC drains 225' of very active ditch. A 10' long 1/2 round downspout has been attached that is now simply hanging in space. An 18'Wx32'Lx4'D gully has been created in OBF. This hole is actively eroding. A skid road to right contributes significantly to this site. Future erosion from continued gully incision to stream below. | H | 0 | 225 | 17 | HM | 1. OSR - KD 190' right road. Stop at through-cut just above this DRC.<br>2. Install two 18" x 40' DRCs to right.<br>3. Attach an 18"x20' downspout to DRC at site with a 33' elbow. |
| 26 | Stream crossing | An undersized 30" CMP drains a 5x2 class 2 stream as well as a diverted 4x1 class 3 (site #27). The diversion will be treated but pipe is still likely too small. Pipe is short and shallow with a half-round downspout attached to outlet. This gets flow to BOT but not quite. | HM | 0 | 110 | 238 | HM | 1. Excavate from TOP to BOT and replace existing pipe with a 36" x 70' CMP at channel grade.<br>2. Install a critical dip to left hinge. |
| 27 | Stream crossing | A rowdy 4x1 class 2 diverted down skid to IBD and then down road 90' to site #26. Perfectly good natural channel awaits reconnection across landing. Reconnect stream and use spoils to bury ditch, skid, and diversion potential to the left. | H | 0 | 140 | 0 | HM | 1. Excavate from TOP to BOT. Install a 30" x 90' CMP in axis and at channel grade.<br>2. Add critical to left hinge.<br>3. Store spoils locally on landing. |
| 28 | Stream crossing | A 2x1 class 3 stream hits IBR and diverts to right. Flow now joins stream of site #27 and diverts to culvert at site #26. An old stream channel exists below road at this spot. | M | 0 | 265 | 122 | M | 1. Install a 24" X (60) CMP in notch and at angle.<br>2. Armor steep OBF with 9 cubic yards rip-rap.<br>3. Install a critical dip to left hinge.<br>4. OSR - FD 265' right.<br>5. Install one rolling dip right. |
| 29 | Stream crossing | A 2x1 class 3 stream flows through a 24" CMP. Pipe is set shallow and high in fill. Outlet is set on fill 10' to right of CLP (see sketch) and then downspouted for 10'. There is a 6' vertical drop to bottom. Right IBD is very springy. There is a big earth flow between this site and site #30. This is not road related but these active springs are part of it. Keeping them flowing to this left hingeline is better than piping them onto the earth flow surface. | HM | 0 | 180 | 94 | M | 1. Replace existing CMP with a 30" X (60) to accommodate stream and extensive springs. Get outlet to bottom.<br>2. Install critical dip to left hinge.<br>3. OSR - KD 180' right.<br>4. Armor lower 1/4 fillslope with two cubic yards rip-rap. |
| 30 | Stream crossing | Steep 3x1 class 2 stream drained by 24" CMP installed high in the fill. With a 10' 1/2 and downspout. Pipe shotguns 4' and has washed out fillslope (20x20x5 = 74 yd3) which happens to be on the right edge of a landslide. 110' of road/ditch contributes from the right DP to the left. | H | 0 | 110 | 96 | H | 1. Excavate top to bottom replace with 24" X 60' in axis at grade.<br>2. OSR - FD 110' to the right.<br>3. Add critical dip to left hinge.<br>4. Armor lower 1/4 OBF with 2 cubic yards rip-rap. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 031 | Stream crossing | A 2x1 class 3 flows into a short and shallow 24" CMP. Pipe also receives flow from a very active IBD which cuts across a springy earthflow to right. An 11' drop exists below short CMP. Pipe is also set far to left of CLP and stream makes sharp right turn 20' below road. The pipe, however, appears to be functioning and stream channel below looks stable with a downspout. This crossing should be OK. There is DP to left. | ML | 0 | 320 | 0 | ML | 1. Install a 24" X 10' downspout with 32" elbow.<br>2. Install 2 - post trash rack to inlet.<br>3. Install a critical dip to left hinge.<br>4. OSR - KD 320' right road.<br>5. Install one rolling dip right. |
| 32 | Gully | Road crosses an old deep-seated landslide. Feature is grassed over, yet hummocky with scarps and slumps above RD. Springy ditch drains to this low spot and flows have cut 10Wx4Dx35'L + 52 yd3 gully in OBF. Low gradient lobe of old slide material attenuates delivery rate by 50%. 2.5" headcut in gully is migrating into road surface and has reduced width to 9'. Spring flows saturate this section of road. | HM | 0 | 123 | 26 | HM | 1. OSR - KD 120' to the right.<br>2. Install 1 18" x 20' DRC with an 18" x 20' downspout. |
| 33 | Ditch relief culvert | A 15" DRC drains 800' of active IBD including an active swale 75' to right. A 10' 1/2 round downspout has been attached that now dangles in mid-air. A massive gully estimated at 8x8x700' runs to class 2 below. Much of this gully has stable banks but there are plenty of active raveling banks. DRC is 70% plugged with organics. Future erosion is a conservative estimate of gully incision and bank raveling. | H | 0 | 800 | 103 | H | 1. Install an 18"x40' DRC 75" to right at point of small concentrated flow at swale.<br>2. OSR - FD 725' beyond this swale.<br>3. Install 5 rolling dips to right. |
| 34 | Stream crossing | 2x1 class 3 stream drained by 15" aluminum pipe with 10' 1/2 round downspout. Pipe is installed high in the fill and to the left of the axis cutting an 8x4x16 = 19 yd3 gully through fill. Very slight DP to left 672' of right approach delivers. Steep OBF will require armor. Lots of organics in channel above crossing. | HM | 50 | 672 | 127 | HM | 1. Excavate top to bottom. Replace with 24" x 60' CMP in axis at grade.<br>2. Add critical dip to left hinge.<br>3. Install trash rack.<br>4. OSR - FD 722' - 672' to the right and 50' to the left.<br>5. Add four rolling dips to right approach.<br>6. Armor steep OBF with 21 cubic yards rip-rap. |
| 35 | Ditch relief culvert | A 12" DRC drains 240' left road, 900' of skid and of right road. A 2x1x525' to class 2 below. Ridge above pipe is heavily skidded and road to left is a landing, so good road drainage will be difficult here. | HM | 1140 | 310 | 20 | M | 1. Install nine XRDS up skid 80' to left.<br>2. OSR - FD 310' right.<br>3. Install two rolling dips right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 36 | Ditch relief culvert | 15" aluminum DRC with trash rack against inlet drains 100' of left approach and 504' of right. DRC drains very springy cutbank and flows. 2'x1'x500' gully/channel down steep hillside is fairly stable. 504' of right approach has a wet ditch from numerous seeps and springs. | ML | 100 | 504 | | ML | 1. Replace DRC at site with 18"x30'. 15" in place will probably serve with additional DRCs up road but remove or correctly install trash rack.<br>2. Install two additional 18"x30' DRC up right approach.<br>3. OSR - KD 100' of left approach and 504' of right approach. |
| 37 | Stream crossing | A slightly undersized 18" pipe receives flow from a small 2x0.5 class 3 stream and a very active spring flowing into the ditch. Pipe is set very shallow and an 8' drop exists below shotgunned outlet. A 20'Wx30'Lx3'D wedge of OBF has failed in past due to poor pipe installation. | ML | 0 | 490 | 88 | ML | 1. Replace pipe with a 24"x60. Get pipe outlet to channel bottom.<br>2. Armor steep OBF with 11 cubic yards rip-rap.<br>3. Install a critical dip to left hinge.<br>4. OSR - FD FOR 100' right from inlet.<br>5. OSR - FD 390' right road beyond keep ditch.<br>6. Install two rolling dips right road. |
| 38 | Ditch relief culvert | 18" DRC with 10" 1/2 round downspout drains 359' of road/ditch. The 150' just above DRC has a springy cutbank. Half round downspout is poorly installed with 3' shotgun outlet that has caused a small 4 yd3 gully. Bench area below allows fines to drop out. Upper 209' of right approach doesn't need a ditch. | L | 0 | 359 | | L | 1. Install 18" x 20' downspout with 27 degree (?) elbow and two connectors.<br>2. OSR - KD 150 up right approach from inlet.<br>3. OSR- FD remaining 209' of right approach.<br>4. Add one rolling dip to this reach. |
| 39 | Stream crossing | A 3x1 class 3 stream flows through an extremely short, shallow, and undersized 18" CMP. Pipe outlet is recessed in fill and a 6'Wx25'Lx15'D gully has been created in OBF. A 15 cubic yard wad of fill and organics lies at bottom. There is DP to left. Some small trees will need to be removed to get pipe installed to bottom of excavation. | HM | 0 | 470 | 183 | HM | 1. Replace existing pipe with a 24"x50. Get pipe outlet to channel bottom.<br>2. Remove 15 cubic yard wad of fill and organics at bottom.<br>3. Armor steep OBF with ten cubic yards of rip-rap.<br>4. Install a critical dip to left hinge.<br>5. OSR - FD 470' right road.<br>6. Install three rolling dips right.<br>Spoil ~800' to left |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 40 | Stream crossing | 3x1 class 2 stream drained by 18" CMP. Installed high in fill with outlet against redwood stump. 486' of right approach delivers to site. Ditch is actually a 2x1 stream from spring flows. Ditch active and downcutting. Large berm at IBR to channel stream/ditch. Flows to inlet (see sketch). DP to the left. Sooner or later the stump will undercut to the point of failure. | M | 0 | 486 | 116 | HM | 1. Excavate top to bottom. Remove redwood stump. Install 24"x60' CMP in axis at grade.<br>2. OSR - KD 486' to the right.<br>3. Install three DRC to the right to drain ditch.<br>4. Armor entire OBF with 14 cubic yards rip-rap. |
| 41 | Ditch relief culvert | An 18" DRC drains 325' of extremely active ditch from right. The road to right is very broad and insloped and the cutbank is very springy. A 10' 1/2 round downspout has been attached to outlet. A 5' vertical drop into a 3' deep hole exists below it. Future erosion is estimated gully incision to creek below. | M | 0 | 325 | 10 | ML | 1. OSR - KD 325' right road.<br>2. Install two 18"x40' DRCs to right. |
| 42 | Ditch relief culvert | A 15" DRC drains 760' of very active IBD from right. A 10' 1/2 round downspout has been attached to outlet. Future erosion is from estimated gully enlargement to class 2 stream below. | HM | 0 | 760 | 9 | M | 1. OSR - KD 100' right road from inlet.<br>2. Install RD right.<br>3. OSR - FD 530' right road beyond first 100'.<br>4. Install an 18"x30' DRC at active spring 630' right (flag hung).<br>5. OSR - KD another 150' to right of DRC install.<br>6. Install four rolling dips to right. |
| 43 | Stream crossing | 30" aluminum pipe drains 3 streams that coalesce 55' above xing. Xing overtopped this winter and blew out a 15'w x 15'l x 5'd= 42cy hole in OBF. Xing is an old Humboldt with new culvert installation very shallow on top with 20’ long half-round downspout. Channel is downcutting through stored sediment above xing. 3' diameter logs in fill. 150' of springy ditch delivers from right approach with an additional 400' of contributing road above that. | H | 60 | 550 | 612 | H | 1. Excavate from TOP to BOT. Replace existing pipe with 30" x 100' CMP in axis and grade.<br>2. OSR-KD initial 150' to the right.<br>3. Add 1 18" x 30' DRC to right.<br>4. OSR-FD upper 400' of right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 44 | Stream crossing | A 7x1.5' class 2 stream has an undersized 20" CMP installed. Pipe outlet is 15' to left of CLP. A 10' downspout is installed but is still shotgunned 6'. This alignment places stream flow on base of OBF and an 8'w x 2'd x 25'l failure has occurred at OBF because of it. An active spring 72' to left flows across road and creates a 1x1x27 gully in OBF. Add 1cy to future erosion. | HM | 113 | 265 | 126 | HM | 1. Excavate from TOP to BOT. Replace existing CMP with a 30" x 50' CMP. Move outlet to right side of two 1.5' diameter fir trees in OBF. Pipe will be in better alignment with stream and re-stabilize OBF to right.<br>2. Install an 18" x 30' DRC with a 10' downspout 72' to left at spring.<br>3. Armor steep OBF with 21cy of 1' rip rap.<br>4. OSR-FD 265' right.<br>5. Install 1 rolling dip to right. |
| 45 | Stream crossing | Recently installed 60" aluminum pipe is high in fill on top of Humboldt logs. Installation is so new that the half-round downspout has not had time to fail. 120' of left approach and 197' right deliver to crossing. | M | 120 | 197 | 377 | HM | 1. Excavate TOP to BOT. Replace existing pipe with a 60" x 90' CMP in axis and at grade of channel.<br>2. OSR-FD 317' (197' of the right and 120' of left)<br>3. Add 1 rolling dip to right approach. |
| 46 | Ditch relief culvert | An 18" DRC receives flow from right road. The IBD does not look very active but a 2x1x120' gully runs to class 2 below. Outlet lies within fill but 10' long 1/2 round gets flow to OBF. Future erosion is from gully enlargement. | ML | 70 | 1295 | 5 | ML | 1. OSR - FD 1295' right road.<br>2. Install six rolling dips right. |
| 47 | Stream crossing | A 2x1 class 3 stream flows through an undersized 15" CMP. Pipe is set shallow and has little headwall. A large past diversion gully exists below road to left. An active spring emerges from cutbank ~75' to right and flows down IBD to this pipe. A small hole in roadbed at IBR looks like some mid-fill piping is happening. | HM | 0 | 470 | 72 | M | 1. Replace existing pipe with a 24"x60'.<br>2. Install critical dip to left hinge.<br>3. Install an 18"x50' DRC at emergent spring 75' to right.<br>4. OSR - FD 470' right.<br>5. Install three rolling dips right. |
| 48 | Stream crossing | Short 18" aluminum pipe installed high in fill to right of stream axis drains 2x1 class 3 stream. DP to the left. Outlet shotguns 5' and has cut 7x5x20 = 26 yd3 gully in right hinge at OBF. | M | 0 | 419 | 127 | ML | 1. Excavate top to bottom. Replace with 24"x60' CMP in axis at grade.<br>2. Add critical dip to left hinge.<br>3. OSR - FD 419' up right approach.<br>4. Add two rolling dips to right approach.<br>5. Armor steep OBF with 15 cubic yards rip-rap. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 49 | Stream crossing | A 2x1 class 3 stream flows down an old tractor trail. It crosses Inman Road in an undersized 15" CMP. Pipe is short and set very shallow. An 8' drop exists below shotgunned outlet. A 7'Wx10'Dx15'L hole has been created in OBF. | HM | 0 | 400 | 109 | HM | 1. Replace existing pipe with a 24"x60'. Get outlet to channel bottom.<br>2. Install a critical dip to left hinge.<br>3. Add ten cubic yards of rip-rap to steep OBF.<br>4. Cut/clean ditch for 140' right.<br>5. OSR - FD 210' right beyond small thru-cut.<br>6. Install one rolling dip right. |
| 50 | Ditch relief culvert | 18" aluminum DRC drains 1460' of left approach, the last 200' of which collects spring flows. DRC, shotguns 4' at outlet, but addition of an 18"x20' downspout and the problem is solved. Inlet is clogged with vegetation so install trash rack also. | M | 1460 | 0 | | ML | 1. Clean DRC.<br>2. Add an 18"x20' downspout.<br>3. Add a trash rack.<br>4. OSR - KD 200' to the left.<br>5. OSR - FD the 1260' of left approach above that.<br>6. Install 6 RDs to left road. |
| 51 | Stream crossing | Small (80'x80') pond formed above road. At high flows pond drains at right hinge into IBD and down road 250' to site #52. Ditch is active in only 25% of length but with significant flows. Road is thru-cut 60% of the way down to site #52. May be difficult to install critical dip here. Do not drain as it is valuable frog, etc habitat. | HM | 510 | 0 | 145 | HM | 1. Excavate top to bottom. Install 24"x80 CMP in axis at grade (DO NOT DRAIN POND)<br>2. Add critical dip to right hinge if feasible.<br>3. OSR - FD 510' to the left.<br>4. Construct four rolling dips up left approach. |
| 52 | Stream crossing | A 3x1 class 3 has had its channel heavily tractored. Flow hits IBD and diverts to right along with diverted flow from site #51 to a 24" CMP. A large but well established gully runs downslope from outlet. A large abandoned road intersects with Inman Road in natural channel of stream. Stream channel has been obliterated years ago. Flow from site #51 will be treated above so flow here will be cut in half. It is more cost-effective and likely less erosive to keep this small stream diverted to where it is. Pipe is installed short and high in fill. | M | 310 | 0 | 147 | M | 1. Replace existing pipe with a 24"x60. Get outlet to small redwood tree in channel at bottom. Move outlet to left ~8' of current pipe to better align with new channel.<br>2. Install a critical dip to right hinge.<br>3. Install one rolling dip to left.<br>4. Cut/clean ditch 100' to left.<br>*Consider a 15' downspout with a 35" elbow instead of pipe replacement. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 53 | Stream crossing | 2x1 class 3 ephemeral stream drains small, springy upslope area. Stream diverted down IBD for 37 feet. Drained by 15" aluminum DRC. Outfalls in stable, mature gully (mossed-over banks). | M | 225 | 0 | 110 | HM | 1. Excavate crossing from top to bottom and place 24"x70 CMP in axis of channel at base of fill.<br>2. Install critical dip on right hinge.<br>3. Install one 18" DRC x40' up left approach.<br>4. Leave existing DRC. |
| 54 | Stream crossing | A 5x1 class 2 is drained by a short 30" aluminum pipe installed high in fill, with a half-round downspout that is failing. A healthy spring 80' up left approach contributes considerable flows and ditch seds to crossing. 194' of left approach delivers. Diversion potential to right. Steep OBF will need armor. | M | 194 | 0 | 315 | M | 1. Excavate from TOP to BOT. Replace existing pipe with a 36" x 80' CMP in axis and at grade.<br>2. Add a critical dip to right hinge.<br>3. Install an 18" x 40' DRC to drain spring approx 80' to left.<br>4. OSR-FD 190' to the left.<br>5. Install 1 rolling dip to the left.<br>5. Armor steep OBF with 21cy 1.5' rip rap. |
| 55 | Stream crossing | A 2x1 class 3 drops off of high cutbank and diverts down IBD to right. Cutbank is gooey mélange but there is not much we can do about the gullying. Flow diverts to site #56. | M | 70 | 0 | 92 | ML | 1. Install a 24"x60 CMP in axis of channel.<br>2. Armor steep OBF with 16 cubic yards rip-rap.<br>3. Install a critical dip to right hinge. |
| 56 | Stream crossing | 3x1 class 3 ephemeral served by 24" CMP outside CLD. Outfalls to stable gully, cut to bedrock with vegetated banks. The damage has been done. No harm in leaving where it is. Outfall needs 10 yards of 6"-12"rock. | M | 170 | 0 | 73 | M | 1. Armor outfall with 10 yards 6"-12".<br>2. Install critical dip.<br>3. Install one rolling dip left.<br>4. Install a trash rack to inlet. |
| 57 | Stream crossing | 2 small 2x1 class 2 streams drain to this 30" CMP. CMP also receives flow from high-water diversions via IBD. This flow comes from 2 or 3 sites up road that will be dealt with by treatment of those sites. If this pipe is sized appropriately, then a downspout would serve well here. 430' of left approach delivers. Diversion potential to the right exists. There are organics in the channel. Poorly designed trash rack installed. 5/5/06- CMP is sized OK. | ML | 430 | 0 | 84 | M | 1. Add a 30" x 20' downspout to outlet.<br>2. Install a critical dip to right hinge.<br>3. OSR-FD 430' up left approach.<br>4. Install a trash rack to inlet.<br>5. Add 2 rolling dips of left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 58 | Stream crossing | A 3x1 class 3 passes through an undersized 15" CMP. Pipe is set ~12' to right of CLP at outlet. Pipe is short and set shallow. A 6'Wx2'Dx25'L gully has been cut into OBF to get flow to natural channel. There is DP to right. | HM | 160 | 0 | 97 | HM | 1. Replace existing pipe with a 24" x 50 pipe at axis of stream and outlet at bottom.<br>2. Armor steep OBF with 11 cubic yards rip-rap.<br>3. Install a critical dip to right hinge.<br>4. OSR - FD 160' left. |
| 59 | Ditch relief culvert | A 15" DRC drains (  )' of left road and active IBD. A large gully has been created from outlet to class 1 below. Pipe also receives flow from skid trail above it (see sketch). Outlet is new shotgunned over a 9' deep hole it has created is OBF. Pipe has high plug potential. Future erosion from further incision into large but relatively stable gully. | HM | 460 | 0 | 30 | M | 1. Replace existing DRC with an 18"x40' pipe with a 20' downspout.<br>2. Install two more 18"x40' DRCs to left.<br>3. OSR - KD 460' LEFT.<br>4. Install two rolling dips left (Do Not drain ditch). |
| 60 | Ditch relief culvert | 18" DRC drains 390' of left approach. Spring flows enter ditch 110' to the left of DRC. 2'x1'x290' gully has been formed by flows. Future erosion based on 25% gully enlargement. Landslide 50' to right of this site probably a result of former install (or lack there of). | ML | 390 | 0 | 5 | M | 1. OSR - KD 110' from spring to inlet.<br>2. OSR - FD 280' above spring.<br>3. Construct three rolling dips up left approach. |
| 61 | Landslide | Ditch flow from the DRC outlet at site #60 recently diverted to right on OBF and saturated a weak hillslope above a class 1 stream. The result was a 40'Wx14'Dx210'L deep landslide to the creek below. The gully below the DRC has been plugged and now ditch flow travels to more stable hillslope at left. A 25'x3'Dx16'L lobe ~20' below OBR is perched to fail but there is little to be done here. To remove this would be expensive and will weaken road stability. Best to treat road drainage at site #60. | HM | 0 | 0 | 11 | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 62 | Stream crossing | 3x1 class 2 stream has had debris torrent down channel that is downcutting through sediments. Flows go subsurface 40' above inlet. Pipe is installed very high in the fill and 10' to the right of axis. Pipe has 20' 1/2 round downspout with 44 yd3 erosion hole below it. Area is heavily skidded. 525' of active ditch with spring flows delivers to site. | H | 625 | 0 | 324 | ML | 1. Excavate top to bottom. Replace with 24"x100' CMP in axis at grade.<br>2. Excavate 50 yd3 of lobe above crossing to daylight channel. Use spoils to rebuild OBF if possible.<br>3. Add critical dip to right hinge.<br>4. OSR - KD 400' to left above inlet.<br>5. Install three 18"x30' DRCs to this reach to drain ditch.<br>6. OSR - FD top 125' of left approach.<br>7. Add one rolling dip to this upper reach. |
| 63 | Stream crossing | A 4x1 class 3 stream flows through a potentially undersized 24" CMP. Pipe is 40% plugged. Pipe is set shallow and outlet is ~11' to right of CLP. Flow dumps onto an old growth redwood stump with a 2' sucker growing from it. Hillslope becomes eroded directly below stump but it is acting as good control for now. If this stump failed we could have erosion problems. | M | 275 | 0 | 151 | ML | 1. Replace existing pipe with a 30"x60 CMP in stream axis and at grade. Pipe should pass 11' to left of outlet and bottom should be at flag.<br>2. Armor steep OBF with 17 cubic yards rip-rap.<br>3. Install critical dip to right hinge.<br>4. Install a trash rack to inlet.<br>5. OSR - FD 275' left.<br>6. Install one rolling dip left. |
| 64 | Stream crossing | An undersized 60" CMP has been placed on top of an old Humboldt crossing at a 14" x 2' class 2 stream. 2'-3' diameter logs stick out of fill at OBF. This is a definite fish barrier. Pipe is short and shotgunned 5'. Eddy at BOT has eaten away OBF and as a result OBF is vertical and crumbling. Huge 4'-5' boulders in stream below BOT. Flow has very recently almost overtopped pipe.<br>An old crossing below this one has eroded banks (site #65) | H | 310 | 525 | 599 | H | 1. Excavate from TOP to BOT. Replace existing pipe with a 72" x 80' CMP. Remove all Humboldt logs in fill and boulders at BOT. Install pipe at channel grade.<br>2. OSR-FD 310' left and 525' right.<br>3. Install 1 rolling dip to left and 3 to right. |
| 65 | Stream crossing | Old washed out Humboldt crossing 60' downstream of new crossing. Channel is pinched and collects LWD that causes flows erode perched material remaining. Lots of large logs remain in fill. | H | 40 | 65 | 116 | H | 113 yd3 estimated fill remaining in crossing but probably closer to 140 calculated. Lots of spoil storage available locally.<br>Decommission crossing. Lay back side at 50%. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 66 | Stream crossing | A likely undersized 54" CMP drains a 10' x 2' class 2 stream. Pipe is installed well at base of fill. High flows have eroded IBF around inlet. If pipe is sized well, this site looks good. IBD from right is active but mainly bedrock and stable. 5/5/06- CMP is sized OK. | ML | 30 | 570 | 253 | M | 1. OSR-KD 300' right to ~20' beyond skid road going upslope.<br>2. OSR-FD 270' beyond this point.<br>3. Install an 18" x 40' DRC to left below skid road intersection.<br>4. Install 2 rolling dips to right.<br>5. Install 4cy 2'-3' diameter rip rap around inlet. |
| 67 | Ditch relief culvert | A 15" DRC drains 510' right road and flow from a cross road-drained skid above. A small 2x0.5x120 gully runs from outlet to class 2 below.<br>Future erosion is from gully enlargement. | ML | 0 | 510 | 2 | ML | 1. OSR - FD 510' right road. Leave DRC to drain flow from skid.<br>2. Install two rolling dips to right and one site. |
| 68 | Ditch relief culvert | 15" DRC drains ( )' of right approach in addition to two small springs. Existing pipe will handle flows from these small springs. Future erosion based on gully enlarging 30% over time. | L | 0 | 250 | 2 | ML | 1. OSR - KD for 80' to the right from spring to inlet.<br>2. OSR - FD 170' above that to site #69.<br>3. Construct one rolling dip up right approach. |
| 69 | Stream crossing | A 3x1 class 2 flows through a 27" CMP. Pipe is set very shallow. A half-round downspout is twisting and failing and dumping flow onto OBF. Pipe is way too short. An active spring emerges from high in cutbank to right ~40'. Flow has been diverted down IBD with the help of a berm. | HM | 0 | 260 | 155 | M | 1. Replace existing pipe with a 30" x 80' CMP set at channel grade. Get outlet to true BOT.<br>2. Install a critical dip to left hinge.<br>3. Maintain ditch for 40' to right to capture spring flow. Maintain berm.<br>4. OSR-FD 260' to right.<br>5. Install 1 rolling dip to right. |
| 70 | Ditch relief culvert | 15" DRC drains 622' of right approach and 120' of skid. Little evidence of gully down fillslope but gully begins to form in swale 300' below. | ML | 0 | 742 | | ML | 1. OSR - FD 622 up right approach.<br>2. Add five rolling dips including one at site.<br>3. Remove existing DRC.<br>4. Install two cross roads drains on skid to right. |
| 71 | Landslide | OBF failure of full bench RD. Road width is 15' here. Steep cutbank inhibits moving road inward. Cracks in OBR. Retaining wall probably the best call here. | M | 0 | 0 | 20 | HM | Construct engineered fill. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 72 | Stream crossing | Poorly installed 24" CMP drains a springy swale and a diverted 2x1 class 3 stream. Pipe is set extremely high in fill. A 14' drop exists below now shotgunned outlet. A 7'x8'x30' long gully now runs down OBF and road edge is near vertical and will fail. Crossing future erosion is attached to site #73. Future erosion here is from OBF erosion if pipe is not dealt with. | M | 0 | 60 | 23 | M | 1) Option 1: (preferable) install a 24" downspout with a 35 degree elbow and back fill large hole at OBF<br>Option 2: Cut outer 10' off of existing pipe; install the same downspout and elbow, and NOT backfill.<br><br>2) Install a critical dip to left hinge |
| 73 | Stream crossing | Steep 4x1 class 2 is diverted via IBD to site #72 result: Evidence that this crossing overtopped many times in the past. Lots of LWD in channel above road. 20'x30" downspout will carry flows past disturbed channel. Due to pipe from site #72. 541' of right approach delivers to site. DP to left. | H | 0 | 541 | 215 | H | 1. Excavate top to bottom. Install 30"x60' CMP in axis at grade.<br>2. Install 30"x20' crossing downspout.<br>3. Add critical dip to left hinge.<br>4. Install trash rack.<br>5. OSR - FD 541' up right approach.<br>6. Add four rolling dips to right approach.<br>7. Armor OBF with ( ) yd3 of .5'-1.5' rock. |
| 74 | Stream crossing | A small 2x1 class 3 stream flows to an undersized 15" CMP. Pipe is installed extremely shallow and to left of CLP. A 10' 1/2 round downspout dumps flow high up on OBF. A 15'Wx4'Dx40'L gully has been cut into OBF (this began before downspout). A large past diversion gully exists in OBF another 40' to left. DP to right. The first 200' of right road is thru-cut. | M | 0 | 660 | 180 | ML | 1. Remove existing pipe. Excavate top to bottom and install a 24"x40 CMP in axis of channel.<br>2. Install 22 cubic yards rip-rap to steep OBF.<br>3. Install a critical dip to left hinge.<br>4. OSR - FD 460' right road beyond thru-cut.<br>5. Install two rolling dips right. |
| 75 | Stream crossing | Newly installed 24" aluminum pipe at channel grade. Large boulders armor outlet to bottom. Faint critical dip. 452' of right approach delivers. | L | 40 | 452 | 0 | M | 1. Enhance critical dip on left hinge.<br>2. OSR - FD 70' from inlet up right approach.<br>3. OSR - KD 382 up to site #76.<br>4. Install two 18"x30' DRCs to this reach.<br>5. Install 2 RDs to right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 76 | Ditch relief culvert | A 24" DRC drains 380' of active right IBD and drainage coming from a tractored swale above gully. Outlet drains to the start of a class 3 stream ~120' below road. Much of the flow to this pipe comes form a spring 200' to right at cutbank. Future erosion from gully enlargement to stream initiation. | M | 0 | 380 | 3 | ML | 1. Install 18"x40' DRC at point of emergent spring at cutbank 200' to right (flag is hung).<br>2. Place a rolling dip to drain road near same spot.<br>3. OSR - KD first 200' of right road. |
| 77 | Ditch relief culvert | An 18" DRC receives flow from 590' of very active IBD and from a spring emerging just above pipe. Pipe inlet is 60% crushed. Outlet is very high in fill. A 1/2 round downspout dumps flow onto fill and will likely fail soon. Flow exiting rusty pipe is eroding OBF. A 4'Wx3'Dx175'L gully runs to stream initiation below.Future erosion is from continued gullying to stream initiation. | HM | 0 | 200 | 13 | M | 1. Replace existing pipe at site with an 18"x30' DRC and an 18"x30' downspout.<br>2. OSR - KD first 200' right.<br>3. Install three rolling dips right. |
| 78 | Ditch relief culvert | 24" DRC drains springy swale and unknown length of road above. Pipe shotguns 7' and has cut 12"x3'x20' erosion hole (27yd3). Pipe is installed on left hinge of swale and there is a 2'x2'x1' sinkhole in the road bed. 240' of right approach delivers. | M | 0 | 194 | 14 | ML | 1. Install 24"x20' downspout to DRC and fill the sinkhole.<br>2. OSR - FD 240' to the right.<br>3. Add one rolling dip to the right. |
| 79 | Ditch relief culvert | A 24" DRC drains IBD from road above and a springy swale above upper DRC (see sketch). Pipe is set shallow and has eroded a large hole in the OBF. A 7'Wx4'Dx90'L gully runs down to stream initiation below. A 6' vertical drop exists below 1/2 round downspout.Upper DRC (site #80) above has a downspout installed directly to inlet of this pipe. | M | 0 | 500 | 10 | M | 1. Install a 24"x20' full-round downspout to outlet. Consider cutting outer 4' from outlet and installing it to nub.<br>2. Install two rolling dips to right. |
| 80 | Ditch relief culvert | 24" DRC drains springy swale plus left approach with wet ditch. Outlet has 1/2 round downspout that reaches inlet of site #79. | L | 235 | 0 | | L | 1. OSR - KD for 110' to the left.<br>2. OSR - FD 125' above that to site #81.<br>3. Add one rolling dip to left approach. |
| 81 | Ditch relief culvert | A 24" DRC draining a springy swale and left road. A downspout connects this DRC directly to the DRC below site #78. Pipe is big enough and installed okay. Pipe receives flow from 3x1 class 3 ~180' to left. Flow is diverted to this site now but will be treated with site #82.Future erosion for stream crossing is calculated at site #82. | ML | 180 | 0 | | ML | 1. OSR - FD 180' left.<br>2. Install one rolling dip left. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 82 | Stream crossing | 3x1 class 2 stream with fill crossing diverts down right approach into site #81. This channel connects to site #83 on road below 790' of left approach deliver. DP to the right. | HM | 790 | 0 | 210 | HM | 1. Excavate top to bottom. Install 24"x70' CMP in axis at grade.<br>2. Add critical dip to right hinge.<br>3. OSR - FD 790' up left approach.<br>4. Add five rolling dips to left approach.<br>5. Armor OBF with yd3 of .5-1.5' rock. |
| 83 | Stream crossing | A 3x1 class 3 stream on road above has been diverted to pipe at site #81. Now a pipe will be prescribed on upper road at site #82 and one will need to be installed here to usher flows across road and back into old channel. There is a DP to left. | HM | 0 | 390 | 161 | HM | 1. Excavate top to bottom. Top is located just above fallen oak in swale (remove oak). Bottom is located just to right of base of large dead oak in swale. Install a 24"x80 CMP.<br>2. Install a critical dip to left hinge.<br>3. OSR - KD 390' right.<br>4. Install two rolling dips right. |
| 84 | Ditch relief culvert | A 15" DRC drains 455' of left road. A very small gully runs to site #76 below. | ML | 455 | 0 | 2 | ML | 1. OSR - FD 455' road left.<br>2. Install two rolling dips left. |
| 85 | Stream crossing | Stream flows down thru-cut road for 450' at top of the reach. Some high flows flow onto road and proceed 400' down to 48' CMP recently installed. Channel is now pinched to right of road and is incising channel. There is room to move the road 30' to the left for the entire length of this reach and allow stream to re-establish itself in a much less constrained setting. The entire reach is springy and the road remains sodden with nowhere to drain it in its current location. Old road cut to left of current road location provides opportunity for re-routing this road reach. | H | 850 | 0 | 343 | H | 1. Lay back current left bank of stream to 2:1 (6x3x500)<br>2. Excavate TOP to BOT. Replace existing pipe with a 48" x 100' CMP in axis and at grade of stream<br>3. Construct new road 30' to left and upslope of current location.<br>4. Outslope this new road.<br>5. Add three 18" x 30' DRCs to drain springs.<br>6. Add 3 rolling dips to new road.<br>7. Install a critical dip to right hinge of xing. |
| 86 | Spring | Spring class 2 ephemeral emerges 70' upslope in thru-cut on skid. Flows in waterbar on skid to current location on Inman Creek Road. Flow is diverted in ditch for 70' to rusted DRC (#87). | ML | 93 | 0 | 10 | ML | 1. Clean/cut ditch for 50' left.<br>2. Install 18"x30' DRC.<br>3. Install a CD to right hinge. |
| 87 | Ditch relief culvert | 15" rusted DRC with semi-buried inlet drains spring flows from site #86. If #86 is treated then this DRC may be replaced with a RD. | L | 110 | 0 | | L | 1. OSR - FD 90' to the right.<br>2. Replace DRC with rolling dips. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 88 | Ditch relief culvert | Plugged DRC with 100' of left and ( )' of right. First 100' on both sides of pipe have wet cutbanks. OBF has been eroded at outlet. | L | 100 | 150 | | ML | 1. Reset pipe to outlet at bottom of existing sear hole.<br>2. Clean/cut 100' of left and right.<br>3. OSR bottom of approaches.<br>4. Install ( ) rolling dips right. |
| 89 | Ditch relief culvert | Road Reach. Hard to determine direction of flow. No gully at outlet of downspout on DRC. Two shallow gullies drain down hillslope but don't get past the ditch. This could very easily be a no delivery reach. Water is in flat IBD but does not get across the road. 10' grassy verge beyond outboard tread of road. | L | 400 | 60 | | L | 1. OSR - KD 260' both approaches.<br>2. Clean small sediment fans from ditch. |
| 90 | Stream crossing | Possible stream initiation from emergent ground water. Flows do not make it across the road. Very low immediacy here. | L | 50 | 0 | 75 | L | 1. Excavate top to bottom. Install 24"x60' CMP in axis at grade.<br>2. OSR - FD 50' to the left.<br>3. Add critical dip to right hinge.<br>4. Armor lower 1/4 of OBF with 1 cubic yards of .5'-1.5' rock. |
| 91 | Ditch relief culvert | 16" DRC serves 194' of left and 270' of right, low-gradient road. DRC outlets on past slide with delivery. Slide caused DRC to separate. Slide is also located at intersection with old skid loading down to right to creek. 3x1x125 leads to creek. Gully is stable but sediment transport through the gully from the road is apparent. Both approaches are receiving upslope contributions from a skid via cross road drains. An additional DRC is present on right approach and is treated as part of the site. The DRC right has been installed in past diversion gully from site #92. This diversion gully is also fairly stable with mossed-over banks, but sediment transport from road is evident. Future erosion is based on slight expansion of both gullies. | M | 194 | 270 | 10 | ML | 1. Outslope and retain ditch - 464'.<br>2. Install one rolling dip left (dip to drain ditch), one rolling dip right drain road only.<br>3. Replace existing DRC with 18"x30' CMP and relocate inlet 35' to right. Relocate outlet off right edge of slide block into redwoods.<br>4. Install two additional DRCs right, one to left of diversion gully and one to right of diversion gully.<br>5. Remove existing DRC from diversion gully. |
| 92 | Stream crossing | A debris torrent down the channel has choked this stream. Channel is incising through seds above crossing. Pipe is installed to left of stream axis and very high in fill. There is diversion potential to left. 306' of right approach delivers. Channel above crossing should be cleaned out. | H | 0 | 306 | 282 | HM | 1. Excavate from TOP to BOT. Install a 24" x 90' CMP in axis of stream and at grade.<br>2. Install a critical dip to right hinge.<br>3. OSR-KD initial 100' to right of xing.<br>4. OSR-FD 206' up road to break in slope.<br>5. install 1 RD to right |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 93 | Stream crossing | 4x1 class 3 ephemeral with 2x1 tributary coming in from left, 40' up from inlet. All flow goes subsurface at confluence. Top is located just below confluence at large boulders in channel. During high flows CMP carries water. Flow also diverts down right ditch during high flows and exits road prism over OBF 50' down from crossing. Past diversion gully present. | M | 210 | 0 | 516 | M | 1. Excavate crossing from top to bottom and place 30"x90' CMP in axis of channel at base of fill.<br>2. Install trash rack.<br>3. Install critical dip on right hinge.<br>4. Outslope 210' of left approach.<br>5. Install one rolling dip left.<br>6. Stone spoil locally.<br>7. Armor OBF with 2 cubic yards of .5'-1.5' rock. |
| 94 | Stream crossing | A 5x1 class 2 stream is drained by a 30" aluminum pipe. Pipe is short and downspout with slot on top is connected to a 30' half-round downspout that carries flows beyond BOT but it has failed. Gullies in OBF indicate that crossing has overtopped in the past. If the pipe is sized correctly, a 30" x 30' full-round downspout should be OK as long as left approach is disconnected. OBF is vegetated with ferns and berries. | M | 626 | 0 | 362 | M | 1. Install a critical dip to right hinge.<br>2. OSR-FD 626' up left approach.<br>3. Add 4 rolling dips to left approach. |
| 95 | Ditch relief culvert | 440' of left and 160' of right drain to low point in road drained by 6" DRC. DRC outlets in possible diversion gully from site #97. Past landslide is present to left on ODF. Multiple skids coming off cutbanks connect to road in this location. Bowed trees up and down slop suggest deep seated feature. | L | 440 | 160 | 5 | ML | 1. Outslope and remove ditch 440' left and 160' right.<br>2. Install two rolling dips left.<br>3. Critical dip at site #97 will serve portion of right approach.<br>4. Leave DRC in place--currently draining small spring. |
| 96 | Stream crossing | The stream goes subsurface 30' above the pipe inlet that is installed high in lobe of fan material. This material is collapsing back into the inlet. 7' from inlet a hole ripped in top of pipe by ditch maintenance activity. Outlet installed 25' to right of axis, but 75 degree elbow and a half-round downspout discharge flows back to the left. High flows have eroded 55cy into channel. Flows emerge 92' below road in channel. Diversion potential to the left. 260' of right approach delivers to the site. Three 18" diameter firs on OBF will need to be removed. | H | 0 | 260 | 1067 | HM | 1. Excavate from TOP to BOT. Replace existing pipe with a 24" x 150' CMP in axis and at grade.<br>2. Add a critical dip to left hinge.<br>3. Add 1 rolling dip to middle of landing to drain ditch to low spot in landing. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 97 | Stream crossing | 4x1 class 3 ephemeral serviced by 24" CMP at low angle, shotgunned with 13' drop. Old pipe buried in fill below present outlet. Old pipe is running more water than current CMP. Downstream channel is strewn with twisted culvert, suggesting past crossing failure. Low gradient approaches feed to inlet. | M | 275 | 200 | 920 | M | 1. Excavate from crossing top to bottom.<br>2. Install 30"x130' CMP in axis of channel at base of fill.<br>3. Outslope and remove ditch both approaches.<br>4. Install two rolling dips left and two rolling dips right.<br>5. Store 162 cubic yards locally.<br>6. Armor OBF with five cubic yards of .5'-1.5' rock. |
| 97.1 | Stream crossing | 2x1 class 3 drained by 15" aluminum pipe installed very high in the fill to the left of stream axis. Outfall gullies right bank down to natural channel. Flat approaches are not problems. | ML | 85 | 30 | 141 | L | 1. Excavate top to bottom. Replace with 24"x60' CMP in axis at grade.<br>2. OSR - FD both approaches (85' left and 30' right).<br>3. Add one rolling dip to the left.<br>4. Armor OBF with 16 cubic yards of .5'-1.5' rock. |
| 98 | Stream crossing | Small 2x.5 stream has cut 22'Lx4'Wx4'D = 13 yd3 PE gully through abandoned road. Road has cross road drains every 150' and is in OK shape. Lay back channel at 2:1 (22"x4'Dx8'W = 26 yd3). | ML | 150 | 0 | 20 | ML | Decommission crossing. Lay back sides at 2:1.<br>Store spoils locally. |
| 99 | Gully | Emergent ground water on roadbed and cutbank is causing gullying of cross road drain. 1x1x100 extends from stream through OBF and is headcutting into road. Future erosion based on gully expansion. | L | 130 | 0 | 8 | L | 1. Decommission outslope 130' of left and install one cross road drain. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 100 | Stream crossing | Humboldt crossing on I.S. #2 receives flow from site #7 on Inman Creek Road. Currently flow goes subsurface at top. At higher flow levels, stream is diverted down left for 100', where it exits OBF across road to area of past hillslope debris slide (20x10x200 from top of OBF to creek). Active 2x1x200 is present down axis of slide. 45' of outsloped right approach is connected to site. Inventoried as an upgrade, need to check whether these roads will be decommissioned. If road is decommissioned, 45' connected from cross road drain. If upgraded and opened, then 160' from intersection with Inman Creek Road and outsloping and dipping to be added.Lots of big wood in fill -. | H | 0 | 45 | 235 | M | 1. Excavate crossing from top to bottom and place 24"x60' CMP in axis of stream at base of fill.<br>2. Install critical dip on left hinge.<br>3. (see comments above) Outslope and remove ditch 160' right and install one rolling dip.<br>4. Armor OBF with 21 cubic yards of .5'-1.5' rock. |
| 101 | Stream crossing | 3x1 class 3 stream with pulled crossing. This crossing needs additional excavation to straighten channel, drop in 24"x40' CMP. 460' of right approach delivers. DP to the left when treated. | L | 0 | 460 | 30 | M | 1. Straighten channel install 24"x40' CMP.<br>2. Add critical dip to left hinge.<br>3. OSR - FD 460' up right approach.<br>4. Add three rolling dips to right approach. |
| 101.1 | Stream crossing | Washed out stream crossing. It appears a log bridge 60' upstream was the original drainage structure. It looks like it was hit by large landslides from both sides of the creek. If this road is to be re-opened a bridge will be needed here. The steepness of the left approach will be a limiting factor. We recommend leaving this situation as is. | L | 60 | 80 | 0 | | NO TREAT |
| 102 | Stream crossing | 4x1 class 2 stream has washed out fill crossing. Channel walls are 5' vertical and calving into channel. 8' diameter redwood stump above road allows stream flows to pass almost directly underneath. Removing this stump may not be an option but it makes inlet placement problematic. There is room to move road alignment out 10' and this should do the trick. 170' of right approach with spring flows delivers to site. DP to the left if treated. | HM | 20 | 170 | 59 | HM | 1. Ease 10 yd3 lobe of material near base of stump to open room for pipe inlet. Level channel.<br>2. Install 30"x50' CMP in axis and backfill.<br>3. Add critical dip to left hinge.<br>4. OSR - FD 170' to the right.<br>5. Install 18"x30' DRC to drain spring 90' to the right. |
| 103 | Spring | Spring at base of cutbank drains off roadbed via cross road drain, and has carved a 1x1x15 through the fillslope. Beyond fillslope, flows here triggered a shallow debris slide (20x9x1) that delivered directly to Inman Creek. | L | 0 | 70 | 2 | L | 1. Outslope and keep ditch 70' right.<br>2. Install one rolling dip right.<br>3. Install 18"x30' DRC with 30' downspout to drain spring. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 104 | Stream crossing | A 7'x2' class 2 stream has washed out an old Humboldt xing. Channel is at grade but walls are oversteepened and calving into the stream. Lobe of material (6'wx10'lx5'd=15cy) at top of xing is perched and will fail. Juncus grass is growing on both approaches. Left approach is a small landing with ponded water. Large Humboldt logs remain in fill. | M | 200 | 130 | 73 | HM | 1. Excavate from TOP to BOT. Remove lobe before waterfall. Remove old Humboldt logs. Give channel a 7' channel width. Lay back banks 2:1. Spoil ~88cy locally. |
| 105 | Stream crossing | Old crossing on abandoned road (road barely discernable) located at confluence of three first order streams. Stream has diverted at crossing in the past, creating an average 8x8x500' gully down the road, which parallels stream on left bank. Not much is left of road. Gully is stable. Equipment access to site is nearly impossible without reconstruction of 500' of road. Stream may occupy gully in future, but gully is large and looks stable. | H | 5 | 5 | | | No treat. |
| 106 | Stream crossing | 1x1 originating from upslope headwall runs down thru-cut skid to thru-cut ford approach on IS 3. Flows run down thru-cut for 40' before entering Inman Creek at the ford (1x.5x20). | M | 0 | 115 | | | No treat. |
| 107 | Stream crossing | Ford crossing an abandoned road. Approaches are grassed over and low-gradient. If this road were to be reopened, rocking the approaches would make this ford usable (100' in each direction). | L | 70 | 40 | | | No treat. |
| 107.1 | Stream crossing | 2x1 class 3 ephemeral--could be skid flow or small skidded channel empties onto road, depositing most of its material. Flow diverts down road for 20' and empties to stream. | M | 0 | 50 | 12 | ML | 1. Decommission crossing. Lay back banks at 2:1 |
| 108 | Road surface | 350' of insloped inner gorge road outfalls to Inman Creek at site. Road surface has been ripped and is grassed-over, but some delivery is occurring. 0.1'/20 yd is probably appropriate for this road. Good candidate for decommissioning. | L | 0 | 350 | | L | 1. Install three cross roads drains. |
| 109 | Stream crossing | 4x1 class 2 with washed out/pulled crossing. Channel sides are laid back at 2:1 and mossed-over. 531' of right approach deliver. There will be DP to the left if treated. | L | 0 | 531 | | L | 1. Add four cross road drains to left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 110 | Stream crossing | 4x1 class 3 stream has broadcast large gravel fan onto road and diverted 75' down road left to old debris torrent track and cut 5'Wx4'Dx30'L gully down to floodplain of possible class 1 stream below. | HM | 0 | 450 | 22 | HM | 1. Add three cross road drains to right approach.<br>2. Decommission crossing. Lay back banks to 2:1.<br>3. Store spoils to left to prevent diversion. |
| 111 | Stream crossing | 4x1 class 3 ephemeral stream on abandoned road flows to Inman Creek via cross road drain in axis of stream. Crossing is roughly 20% pulled. | M | 0 | 250 | 105 | M | 1. Install 2 cross road drains.<br>2. Decommission crossing. Lay back sides to 2:1. |
| 112 | Stream crossing | Ford on class 1 stream. Both approaches abandoned. If road is to be reopened bridge should be installed. i.e. flat car during low water, and pulled for the wet season. | L | 0 | 412 | | L | 1. Install three cross road drains right. |
| 113 | Gully | Spring cutbank flows down IBD and crosses KD at cross road drain. 3'x1'x80' gully down OBF to class 1 stream. Future erosion based on 100% gully enlargement. | M | 399 | 0 | 9 | ML | 1. OSR - KD 399' up left approach.<br>2. Install three 18"x30' DRCs drain spring flow from ditch. |
| 114 | Stream crossing | Stream has had debris flow that caused a log jam above crossing. Flows have cut through left hinge of jam causing an “S” turn through the crossing. High flows divert to the left and have completely obliterated lower road to the left. Road bed is now a chasm. Big time work to be done here. ~100 yd3 of debris needs to be excavated to realign stream. Road can be moved 10' out. 500' of left approach delivers, yet there is DP to the left. | H | 500 | 70 | 128 | H | 1. Excavate ~100 yd3 mound above crossing. Store locally.<br>2. Lay back banks at 2:1 for decommissioning.<br>3. Add four cross road drains to left approach.<br>4. Store spoils on road to left. |
| 115 | Stream crossing | 3x1 class 3 ephemeral stream drains to cross road drain. 50% of crossing has been pulled. DP to right. | HM | 232 | 0 | 14 | M | 1. Excavate crossing from top to bottom. Lay back sides to 2:1 for decommissioning.<br>2. Install three cross road drains. |
| 116 | Stream crossing | 2x1 class 3 ephemeral drained by cross road drain. No diversion potential. This road should be decommissioned. | M | 0 | 0 | 5 | L | 1. Excavate crossing from top to bottom. Lay back sides to 2:1 for decommissioning. |
| 117 | Stream crossing | 3x1 class 3 ephemeral stream and spring flow drain to cross road drain at terminal landing. Gullying apparent on fillslope of landing. Steep hillslope below.*Road should be decommissioned.*<br>**EOS IS-3.2.1 | M | 0 | 0 | 191 | ML | 1. Excavate crossing from TOP to BOT with 4' channel width and lay back slopes to 2:1. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 118 | Stream crossing | 3x1 class 3 ephemeral from site #115 above diverts down right, where it has carved a 6x8x40 through the fillslope. Most of the transported material is deposited on a low-gradient stream-side bench before entering the channel. On hillslope above crossing, the stream bifurcates at a cluster of redwoods. Currently it is favoring the right, but has recently opened the left. Subsurface flows are emerging in the left channel near Inman Creek. | H | 200 | 0 | 21 | M | 1. Excavate left from top to bottom and lay back banks at 2:1 for decommissioning. Use spoil to prevent lower channel from diverting down road. |
| 119 | Stream crossing | 3x1 class 3 stream drained by fill crossing--fill portion of bench is washed out. Debris torrent down channel causes stream to braid above road. Outfall goes onto slide below, diverts 40' to the right and cuts a 12Wx40Lx10'D gully down to class 1 stream. Road is very overgrown and indistinct beyond this point and does not contribute. | M | 75 | 0 | 73 | HM | 1. Excavate top to bottom. Decommission entire crossing--layback banks at 2:1 through skid below.<br>2. Store some spoil on right of skid to prevent diversion. |
| 120 | Stream crossing | Stream has torrented originating 40' above road. Entire road prism is gone. Void measures 30x12x200 on a 50% slope. Road beyond this is a nearly non-existent track. | HM | 0 | 0 | | | No treat. |
| 121 | Stream crossing | 10x1 completely washed out crossing. No DP. No future. No contributing approaches. No treat. | L | 0 | 0 | | | No treat. |
| 122 | Stream crossing | Washed out 8x2 class 2 stream crossing. Channel is at grade through crossing. A very overgrown road bed continues beyond left bank but we think that this is the outer edge of a terminal landing. Recommend decommissioning here. There is only one small portion of perched fill on right bank and even this is grassed-over and looks stable.<br>No diversion potential. | L | 10 | 40 | 11 | L | 1. Pull back right bank for 20Wx3Dx5L = 11 cubic yards. Spoil locally. |
| 123 | Stream crossing | 4x1 class 2 stream has a fill crossing. Flows have cut a 4'Wx4'Dx45'L gully through the road fill. It would be easy to straighten this channel and install a 30"x40 CMP. If treated crossing will need a CD on left hinge. 560' of right approach delivers. | ML | 0 | 560 | 27 | ML | 1. Lay back sides at 2:1 for decommissioning. Store 32 cubic yards of spoil locally.<br>2. Add four cross road drains up right approach. |
| 124 | Gully | A gully coming off of Inman Creek Road at site #33 leads to this site. Site #33 is a DRC and flow to that site will be cut off with treatment. Future erosion here is a 2x2x22 gully running across road bed. A water bar has been placed at site. | ML | 0 | 500 | 2 | ML | 1. OSR - DF 500' right.<br>2. Install two rolling dips right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 125 | Stream crossing | Tiny stream drained by fill crossing. Right approach delivers. Recommend decommissioning. | L | 0 | 370 | 32 | ML | 1. Excavate top to bottom. Lay back banks at 2:1 for decommissioning. 2. Add two cross road drains to the right. |
| 126 | Spring | A small but active spring emerges above road here and flows across it. A 3x2x15' gully has been cut into OBF. A cross road drain has been installed below site. Future erosion is from continued gullying of road bed. | M | 0 | 550 | 1 | ML | 1. Install an cross road drain at spring. 2. Install two cross road drains on upper road. |
| 127 | Stream crossing | 3x1 class 3 has been decommissioned. Channel has been laid back to 23 degrees. Well vegetated and stable. No fill left in crossing. | L | 150 | 0 | | | No treat. |
| 128 | Stream crossing | Another ephemeral stream with pulled crossing. No fill remains. No problem. | L | 90 | 0 | | | No treat. |
| 129 | Stream crossing | A 2x1 class 3 stream crossing has been pulled. Banks are laid back well and are stable. Road bed is well outsloped with large cross road drains. No future erosion here. | L | 25 | 20 | | | No treat. |
| 130 | Stream crossing | Decommissioned 2x1 class 3. No fill remaining in crossing. | L | 30 | 0 | | | No treat. |
| 131 | Spring | Springy swale drains to deep waterbar. Outfall flows to site #46 on Inman Creek Road. If road is to be re-opened spring should be drained with DRC. 350' of left approach is well-drained with cross road drains at present but will need OSR-FD and rolling dips if re-opened. Spring 60' down road from site #132 will need a DRC if road is re-opened. | ML | 350 | 0 | 22 | ML | 1. Add three cross road drains to left approach. |
| 132 | Stream crossing | Pulled stream crossing with stable and grassy banks. Connecting roadbed to left is grassy and stable as well. Stream is a 3x1 class 2 and runs to site #69 below. If this road is to stay decommissioned, leave it alone. | L | 1200 | 12 | | L | 1. Install 10 cross road drains to left. |
| 133 | Stream crossing | Pulled crossing of 4x1 class 2 stream. Mostly bedrock channel. Approaches at 2:1. If upgrade, straighten channel slightly, CMP and backfill will work here. 250' of left approach will need OSR-FD and one rolling dip if reopened. Otherwise is disconnected with hefty cross road drains. | L | 250 | 90 | | L | 1. Add two cross road drains to the left. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 134 | Bank erosion | This is a complicated site. The lower portion of IS 9 comes to within 30' of upper portion. The lower section is right in the channel of a class 2 stream. There are 5'-9' vertical and active banks crumbling into the channel for 205'. This should be pulled back. A landslide on upper section has come to rest on lower roadbed above. 9' tall vertical bank. We must be careful not to further destabilize toe of slide. BOTH upper and lower sections should be decommissioned. Upper road seems to have been already (see site #133). If upgrade, use upper road. This is WAY too close to channel. | H | 80 | 0 | 187 | H | 1. Pull back unstable banks between start and end flags (210'x14x7 = 860 cubic yards).<br>2. Use spoil to rebuild upper road at slide and to rebuild crossing at #133. Spoil extra on landing across from site #135. |
| 135 | Stream crossing | Low gradient ford crossing through grassy meadow. No fill remains in crossing. Approaches grassy and do not deliver. Leave this road alone and develop upper road. | L | 60 | 0 | | | No treat. |
| 136 | Stream crossing | A small 2x0.5' class 3 stream flows across this decommissioned road. We feel this road should be left alone and not upgraded. This is a low flow stream and there is very little fill here as future erosion. A 2x1x20 gully runs down OBF. Channel below road is tractored and there is a decomposing road bed below. Future erosion enhanced gully across road. | L | 70 | 10 | 6 | L | Decommission crossing. Give channel a 4' width thru excavation between TOP and BOT. Lay back banks to 2:1. Spoil locally. |
| 137 | Stream crossing | A 4x1 class 2 stream has had crossing partially pulled. Flows have cut a gully through remaining fill down to grade. Above road a large sediment wedge is eroding and at risk. A headcut is marching through fill. Seds are being filtered by old slash pile beyond BOT, but large sediment fan flows across meadow and into stream below. | HM | 40 | 210 | 40 | HM | 1. Decommission crossing. Excavate from TOP to BOT. Lay back banks 2:1 after give stream a 4' channel width. Spoil locally.<br>2. Install 3 XRDs to right. |
| 138 | Spring | A 2x1 class 3 has had its channel above road heavily tractored. It becomes braided and diffused before it reaches site #139. It discharges out of cutbank as spring flow to right of #139 flows down road and exits at a waterbar to form site #138, this site. A small 1x0.5x20 gully exits OBF to class 2 below. We recommend decommission. Decommission outslope, pull fill, would be best here. | ML | 75 | 6 | 1 | L | 1. Excavate TOP to BOT 25cy. Spoil locally |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 139 | Stream crossing | Small portion of very braided stream that has been highly disturbed up the hillslope above road. This crossing appears to be an old cross road drain installed obliquely at lower (right) hinge. Gully is old and stable down to mainstem. If road is reopened install CMP in stream axis and install critical dip to right hinge.This road should be decommissioned. | ML | 70 | 0 | 16 | ML | 1. Excavate top to bottom. Lay back sides at 2:1 for decommissioning. |
| 140 | Stream crossing | A 3x1 class 3 flows across fill here with no drainage structure in place. The channel has been heavily tractored. A 5'x5'x6' hole has been cut into outer half of road. A 2'x2'x8' gully runs to bottom.<br>We should decommission this road! | H | 320 | 25 | 32 | HM | 1. Excavate from top to bottom. Lay back sides at 2:1 for decommission.<br>2. Install two cross road drains to left approach. |
| 141 | Spring | Spring flows down shallow swale has eroded 1x.5x60 gully across road and down slope to stream. Future erosion based on 100% gully enlargement. | L | 60 | 0 | 2 | L | 1. Drain spring with cross road drain. |
| 142 | Stream crossing | A 6'x1.5' class 2 flows through a potentially undersized 36" CMP. Fillslopes are steep but stable (see profile). Pipe is out of alignment with CLP due to large redwood stump and suckers in OBF. Install is OK if pipe is sized correctly. | M | 110 | 540 | 182 | M | 1. Decommission crossing. Excavate from TOP to BOT. Give stream a 6' channel width. Lay back banks 2:1. Spoil locally.<br>2. Install 4 XRDs right and 1 to left. |
| 143 | Stream crossing | A 6'x1' class 2 stream drained by a 36" CMP installed high in fill. CMP outfalls onto boulder channel with no ill effects. Large stumps on IBF and OBF on right bank will complicate excavation, but OBF stump is holding OBF together. There are very little road contributions from either approach. If pipe is replaced, moving pipe 6' to 10' to the left would attain better alignment and create clearance from stumps. We recommend the decommissioning of this road. | ML | 75 | 70 | 71 | ML | 1. Excavate from TOP to BOT. Give a 6' channel width thru crossing. Lay back banks 2:1. Spoil locally. |
| 144 | Stream crossing | An 8x1.5' class 2 stream flows through a likely undersized 48" CMP. Pipe is set high in fill. Outlet is shotgunned 4' onto a large redwood root wad. There are several large 2'-3' diameter redwood logs in OBF as crumbling brow logs. Crossing may be an old Humboldt but no logs parallel to stream are visible. OBF will fail with collapse of logs. | HM | 740 | 85 | 238 | HM | 1. Excavate from TOP to BOT. Give stream a 10' channel width. Lay back banks 2:1 and spoil locally.<br>2. Install 6 XRDs to left and 1 to right. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 145 | Stream crossing | A fill crossing has lots of suspicious logs protruding from the fill but none are really parallel to the channel. It may not be a Humboldt crossing but the logs are still retaining sediment and should be removed and will lower excavation rate significantly. A large gully has been cut through fill but much fill remains. | H | 50 | 85 | 43 | HM | 1. Decommission crossing. Excavate from TOP to BOT. Give stream a 4' channel width. Lay back banks 2:1. Spoil locally. Remove all logs from channel. |
| 146 | Stream crossing | Two 3x1 streams should join just above this site. They both hit an old road above this one. The right stream seeps through a Humboldt on upper road. The left stream diverts to left on upper road, gullying it badly, hits this road and diverts back to this site at OBR. 90% of fill at this crossing has been washed out. Nearly a dozen large logs exist in channel perpendicular to stream below road. Many yards of sediment is held up by logs. It will be a big job to remove them safely. | HM | 12 | 10 | 60 | HM | This site will be treated in conjunction with #147.<br>1. Option one: Install CMP after straightening channel through washed out crossing. Backfill with 7x7x30 - ~60 cubic yards 2:1 ok.<br><br>2: **Option two (preferable):** Excavate logs and seds below crossing for 5x20x50 = 185 cubic yards of 85% LWD. Beware of destabilizing high fillslope on right bank. This may be native. Pipe install should stay same as above.<br>*Remove stump from channel at top. |
| 147 | Gully | Possibly old skid road has intercepted stream channels far upslope. They have now become large gullies with vertical banks that parallel each other down the slope. Top flag is hung in right hand channel because they need to be combined (see sketch). Estimate 440 yd3 of sediment was stored. Gullies have eroded away 235 yd3 leaving 209 yd3 remaining to be excavated and can be stored 200' to the left. This sediment is at high risk and should be dealt with. | H | 5 | 20 | 209 | HM | 1. Excavate 209 yd3 of perched material and store 200' to the left. |
| 148 | Stream crossing | A 2x1 class 3 stream has no drainage structure installed at road except for a cross road drain. Channel above road is heavily damaged and loaded with debris. Flow crosses wide roadbed in cross road drain and creates a 4x2x25 gully to OBR. | HM | 190 | 5 | 147 | HM | 1. Excavate top to bottom. Install a 24"x70 CMP. Lay back 2:1 between OBR and bottom (beyond 2:1 slope). Spoil locally.<br>2. Install one rolling dip to left. |
| 149 | Stream crossing | Pulled crossing at tiny stream. Banks laid back at 2:1. | L | 100 | 0 | | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 150 | Stream crossing | This is an old ford crossing on a broad 25'x1.5 class 1 stream. Approaches are laid back well and grassy. Nothing has driven across here for a few decades. No future erosion. No treat. | L | 70 | 85 | | | No treat. |
| 151 | Spring | A small spring emerges from cutbank of road at this spot. A dip has been well placed at this spot so flow immediately crosses road. A 1x0.5x30 gully runs downs OBF to stream below. Future erosion from this gully cutting across roadbed. This is not worth bringing equipment out to deal with. | L | 22 | 4 | 7 | | No treat. |
| 152 | Stream crossing | Pulled crossing. Mossy channel, grassy 24 degree banks. No problem here. If this road were to be reopened 30' CMP and 1 hr to backfill and 1 hr for critical dip. | L | 120 | 70 | 0 | | No treat. |
| 153 | Spring | A spring emerges in very small swale ~30' above road. It has been raining for nearly a month straight now so there is flow here. Typically the spring would not exhibit much flow. Future erosion is from flow headcutting across road. A small dip has been placed here to ensure flow crosses road. | L | 130 | 10 | 2 | | No treat.<br>**Install an 18"x30' DRC here is upgraded** |
| 154 | Stream crossing | Pulled crossing. Mossed channel and well vegged channel sides laid back to 2:1. 30' pipe would be needed here if reopened with critical dip on right hinge. | L | 70 | 26 | 0 | | No treat. |
| 155 | Stream crossing | Pulled crossing. The 2x1 class 3 stream is at grade through site. A slight meander will eventually straighten out and cause ~1 cubic yard of future erosion. Banks are laid back to 25 degrees. | L | 18 | 22 | 1 | | No treat. |
| 156 | Stream crossing | A 4x1 class 2 stream crossing has been 95% pulled. Banks have been laid back to 25 degrees and are stable even after recent large storms. Stream has incised into crossing leaving 1'-1.5' vertical banks in a few places. Minor future erosion from these banks laying back can be expected but not worth worrying about. A stump at IBR on left bank is holding up ~10 cubic yards of perched material behind it but looks stable enough to hold it. | L | 35 | 50 | 2 | | No treat. |
| 157 | Stream crossing | Steep 6x1 class 2 stream. Flows have incised 1' through pulled crossing. Channel walls are laid back at 2:1 and well vegged. Very little remains in this crossing. | ML | 40 | 40 | 10 | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 158 | Stream crossing | A 3x1 class 2 stream flows through a 90% pulled crossing here. Banks have been laid back to a 25 degrees. Right bank at OBR is a steeper 35 degrees. Stream flow has incised through outer half of crossing creating 1.5'-2' vertical banks. Future erosion is from this section laying back.<br>Left bank 15'Wx2'Lx2'D = 3<br>Right bank 20'Wx3'Lx30'=7 | M | 45 | 17 | 10 | ML | 1. Excavate ~20 cubic yards from outer portion of pulled crossing. Lay back vertical banks. Spoil locally.<br>**If upgrade, install a 30"x50' CMP and backfill.<br>4 hrs exc./ 3 hrs dozer / 4 hrs labor |
| 159 | Stream crossing | Stream has had debris torrent down channel that took out the road. Slide is vegged with Juncus and ferns now and appears stable, but the road is gone. Does not seem feasible to attempt to open this road beyond this point due to this unstable section. | L | 0 | 350 | 20 | | No treat. |
| 160 | Stream crossing | A near source 2x1 class 3 flows across an abandoned road. A 3'x3x17 gully has been cut into OBF and will continue to cut. Road bed is hummocky and unused. | HM | 21 | 42 | 22 | L | 1. Excavate from top to bottom. Lay back banks 2:1. Give stream 4' channel width. Spoil locally. |
| 161 | Stream crossing | Fill crossing on 3x1 class 2 stream. 3' headcut at OBF. Approaches do not deliver. | M | 75 | 90 | 55 | M | Decommission crossing. Excavate top to bottom. Lay back sides at 2:1. Store spoils locally. |
| 162 | Stream crossing | Tiny stream with fill in it has less that 2cy of fill left in it. It has been well-pulled and banks are laid back. This site is not a problem. | L | 0 | 280 | 2 | | No treat |
| 163 | Gully | 400' of skid road drains to this site. Skid is rilled and gullied. Gully across road is old and laid back well. Banks are grassy except for a few 1' vertical spots. Estimated 4 cubic yards future erosion. | ML | 400 | 120 | 4 | L | 1. Install four cross road drains on skid road above. |
| 164 | Stream crossing | This is a pulled stream crossing. Stream is at grade through crossing. Left approach is grassed over and does not deliver. | L | 120 | 0 | | | No treat |
| 165 | Stream crossing | A small near source 2x0.5 class 3 stream crosses a road intersection here. A cross road drain has been placed at crossing on upper road and lower road has been dipped out. No DP here. Future erosion from future gullying through road beds which will be minimal. | L | 90 | 100 | 2 | L | 1. Excavate a 4'Wx2'Dx35'L channel across both road beds. Spoil locally. |
| 166 | Stream crossing | 2x1 class 2 with fill crossing. Flows have cut 6x5x20 = 31 cubic yards gully through OBF. This is virtually the end of the road with only skids beyond. Skid road runs right up the channel above crossing. | M | 60 | 0 | 41 | M | 1. Excavate top to bottom. Lay back sides at 2:1. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 167 | Spring | A springy swale drains flow onto this low spot in road. Spring is probably only active now due to 30 days of straight rainfall. Future erosion is a minimum estimate. A 1x1x25 gully runs down OBF. This will eventually cut through road bed. Much of the seds filter out on hillslope below.<br>FE is from gullying. Leave site alone if decommissioned (recommended!). | L | 310 | 120 | 1 | L | If Decommission: 1. Install three cross road drains left and one right.<br><br>If upgrade: 1. Cut IBD on 40' of each side of low spot.<br>2. Install an 18"x50' DRC at center. |
| 168 | Stream crossing | Small stream near origin drains across fill crossing. Flows have cut a 7x4x22 = 23 yd3 gully through OBF. 2' headcut is migrating back through road bed. 1400' of right approach delivers. | M | 60 | 1400 | 25 | M | 1. Excavate from top to bottom. Lay back channel sides at 2:1<br>2. Add nine cross road drains to right approach.<br>3. Store spoils locally. |
| 169 | Stream crossing | A near-source 2x0.5' class 3 flows through a slightly undersized 18" pipe. Pipe had two logs wedged in inlet when we got here but there was no sign of pipe over-topping. OBF is well-armored below outlet. Pipe is shallow and set high in fill. Grassy channel. High in watershed. | ML | 210 | 40 | 25 | ML | 1. Replace existing pipe with a 24"x40 CMP.<br>2. Install one rolling dip left. |
| 170 | Stream crossing | Tiny stream near origin in grassy meadow. Crossing is well pulled with stable banks. Channel sides are well vegetated. No problem here. | L | 80 | 80 | 0 | | No treat |
| 171 | Stream crossing | A 3' x 1' class 3 stream flows across what is probably native ground at crossing. Two large old bay trees and a massive fallen (but still alive) oak at OBR are trapping seds above them on roadbed. A hole exits below tress due to subsurface flows eroding soil between roots of bay trees. Flow is now flowing to right around oak tree where it will eventually headcut from the hole. To decommission crossing would require ripping out these old trees which would be lame.<br>Recommend no treat. Future erosion consists of native fill. | ML | 50 | 85 | 58 | ML | 1.Decommission, try to excavate fill from around trees at OBF. Give a 4' channel width and lay back banks 2:1. Spoil ~90cy locally. Excavator production will be ~40cy/hour. |
| 172 | Spring | A spring emerges from a small swale and crosses road here. A cross road drain has been placed in road to prevent diversion down road bed. A 1x1x80 gully runs to stream initiation below. Future erosion from 100% gully enlargement. | L | 3 | 50 | 2 | L | 1. Install an 18"x338' DRC to drain swale across road.<br>2. Install a large rolling dip at site to act as critical dip. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 173 | Gully | 690' of road and inboard ditch drain to this gully located at an off road drain. Flows have cut a 3x4x90' = 40 yd3 and a 1'x3'x690 = 77 yd3 active IBD contributes to this site. The ditch is fed by springs and a partially diverted stream at site. Future erosion based on 100% gully and ditch enlargement. Lower 200' of approach is through cut, so breach berm for RD outlet. Treating site #174 will help this site considerably. 18"x30' DRC will be needed to drain spring 90' below site #174. *See site# 362. | HM | 0 | 690 | 117 | H | 1. OSR - FD 650' of right approach. 2. Cut ditch 40' to collect spring flows. 3. Install 18"x30' DRC to drain spring. 4. Add four rolling dips to right approach. |
| 174 | Stream crossing | A 2x1 class 3 flows across road here with no drainage structure installed. A very small dip exists but part of stream flow has been diverting down right road towards site #173. A 2x1x22 gully has been cut into OBF and will continue across road. A sed wedge exists in swale above road which will need to be removed for pipe installation. *See site# 362 | HM | 1500 | 0 | 43 | H | 1. Excavate top to bottom. Remove wedge above road. Install a 24"x40 CMP in stream axis and at grade. 2. Install a critical dip to right hinge. 3. OSR - FD 1500' left. 4. Install eight rolling dips left. |
| 175 | Bank erosion | Road fill was pushed outright alongside Inman Creek here. There may have been a stream crossing here in the past because a road approaches on the right bank. A row of 3'-4' diameter boulders in channel have trapped some large weedy debris. This blockade has forced Inman Creek into this left bank. This has created a 27'Wx23'Lx13D hole with vertical and very active banks. This will continue to deposit seds into Inman (class 1). | H | 60 | 0 | 236 | HM | 1. Excavate 65'Wx14'Lx14'D = 472 cubic yards. Spoil locally. 2. Remove boulders from channel and use them to buttress fillslope. |
| 176 | Bank erosion | Inman Creek has been pinched by road fill and this has lead to the scouring out of a large piece of road here. A 53'Wx6'Dx9'L chunk of road has already delivered to Inman Creek. Fill face is active and raveling and will continue to deposit seds. | HM | 40 | 0 | 71 | HM | 1. Excavate vertical fill between start and end flags. Volume 53'Wx6'Dx12'L = 142 cubic yards. Remove woody debris in fill at left edge of excavation to slightly widen channel there. |
| 177 | Gully | 255' of IBD drains to this off road drain at intersection of hairpin on Inman Creek Road. And IS 14. Flows have cut gully (4x4x30 = 18 yd3) through OBF. FE based on 100% gully enlargement over time. | M | 255 | 0 | 0 | M | 1. OSR - FD upper 192' of left approach. 2. Add one rolling dip to left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 178 | Stream crossing | A 2x1 class 3 stream flows across road bed here. A 1'x1'x10' gully mid-road turns into a 3'x3'x25' gully to OBF. This gully will expand until entire crossing is washed out. An old madrone covered in poison oak is acting as erosion control at OBF. A large OBF gully has been created below madrone. | HM | 90 | 0 | 111 | HM | 1. Excavate from top to bottom. Give stream a 4' wide channel. Lay back banks 2:1. Spoil locally. Remove madrone at OBF. |
| 179 | Stream crossing | A 4x1.5 class 2 stream is drained by fill crossing that has been washed out. Fill portion of road prism is gone and a 3' headcut is migrating up the channel. Area is springy. | HM | 70 | 0 | 56 | HM | 1. Excavate from TOP to BOT. Decommission xing. Give channel a 5' width. Lay back banks 2:1. Spoil locally. |
| 180 | Stream crossing | A small 2'x0.5' class 3 flows across road here. OBF has been gullying out for a long time but has recently stored when stream got down to large rock chunks. Stream will continue to cut across road, however, so fill should be pulled. | M | 645 | 0 | 37 | M | 1. Excavate from top to bottom. Give 4' channel bottom. Lay back 2:1. Spoil locally.<br>2. Rip road and install seven cross road drains to left. |
| 181 | Stream crossing | Fill crossing diverts small stream down road to site #182 where additional flows are causing incision. Long time since this stream was in the natural channel. 103' of left approach delivers. | M | 103 | 0 | 59 | M | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission.<br>2. Add one cross road drain to left approach. |
| 182 | Stream crossing | A 2x1 class 3 flows across abandoned road here. A 4 cubic yard gully has been created in OBF already. Diverted flow from site #181 delivers to this stream at OBF. Gully will definitely continue to enlarge here. | HM | 55 | 7 | 32 | HM | 1. Excavate top to bottom. Give 4' channel bottom. Lay back banks 2:1. |
| 183 | Stream crossing | Partially pulled crossing of 2x1 class 2 stream. Flows have incised a 2'Wx2'D gully through remaining fill. 198' of left approach delivers. | ML | 198 | 0 | 8 | ML | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission.<br>2. Add one cross road drain to left approach. |
| 184 | Stream crossing | A 3x1 class 3 stream has washed out ~70% of the road fill here. A 1' diameter buckeye tree has fallen across channel at IBR and a sed wedge has developed behind it. There is a 5' knick point in center of road where erosion gully begins. Banks are active and raveling. | H | 140 | 0 | 93 | HM | 1. Excavate from top to bottom. Give 4' channel width. Lay back banks 2:1. Spoil locally.<br>2. Rip road and install one cross road to left. |
| 185 | Stream crossing | Partially pulled crossing of class 2 stream has down cut through fill and washed out the OBF. 212' of left approach delivers. | HM | 212 | 40 | 30 | M | 1. Excavate from top to bottom. Lay back sides at 2:1 for decommission.<br>2. Add one cross road drain to left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 186 | Stream crossing | 3x1 class 3 ephemeral stream with a washed out crossing. Much of the fill has been eroded and delivered. Some downcutting may still occur and the banks may check bank in the process. Two hundred feet of left approach is insloped, with a 3x12x100' berm on the OBF. An active earth flow exists above the left approach and is depositing on the road surface. The additional 44 yards of future is based on the delivering to the stream system. | M | 200 | 0 | 44 | ML | 1. Decommission stream crossing.<br>2. Install three cross road drains on left approach.<br>3. Remove fill from OBF in area of earth flow (+400 cu yds). |
| 187 | Stream crossing | 3x1 class 2 stream has been decommissioned. Boulder/bedrock channel is somewhat stepped due to substrate but it is down to grade. Left bank of channel is steep (38 degrees) at OBF end of channel, but well-vegged with grasses and appears stable. Right bank has tiny stream outfall and is deeply gullied and will continue to erode into stream. Both banks need to be laid back to 2:1. | M | 84 | 38 | 1 | M | 1. Excavate both banks to 2:1 for decommission. Store spoils on either or both sides of site. |
| 188 | Stream crossing | Crossing was partially decommissioned in the past. Flow has subsequently eroded a 26Lx14Dx19W = 256 cy hole in road fill. Banks are very steep and actively calving off into stream. | HM | 106 | 0 | 187 | HM | 1. Decommission crossing. Lay back banks at 2:1. Store spoils locally.<br>2. Install one cross road drain on left approach. |
| 189 | Stream crossing | Fill crossing on a 2x1 class 3 ephemeral. Channel initiates 300' up from crossing in grass land/earth flow area. Stream has diverted to #190 in the past. Roadbed is currently saturated, with juncus present on the road. The stream has eroded a 12x5x75 down the OBF. | M | 300 | 0 | 234 | ML | 1. Decommission crossing.<br>2. Install four cross road drains up left.<br>** +25 cu yds excavate for berm removal. |
| 190 | Stream crossing | Two streams come together here. One stream has been decommissioned and there is no fill left in bedrock channel. Banks well-vegged and stable. The other stream outfalls onto road where it deposits a small fan and merges into decommissioned stream. There is little reason to treat this site. | L | 75 | 40 | 5 | L | 1. Cut 40' ditch to influence streams together. |
| 191 | Spring | 320' of low gradient road located a break in slope with spring earth flow above is collecting emergent water from cutbank and delivering it to a head wall swale. Concentration of flow is causing incision on the fillslope and has checked back to the center of the road. Future erosion based on gully expansion. | ML | 320 | 0 | 20 | ML | 1. Install four cross road drains up left. |
| 192 | Gully | Short, low gradient approach, yet 3'x3'x180' = 60 cubic yards. Active gully exits OBF at outlet of cross road drain. Springy, flashy meadow above road. | M | 165 | 0 | 60 | M | 1. Add two cross road drains to left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 193 | Gully | Road is located at top of lead wall swale and is collecting emergent water from cutbanks. A 2x1x100 gully extends off of the OBF. Future erosion based on gully expansion. | ML | 130 | 0 | 14 | ML | 1. Install three cross road drains. |
| 194 | Stream crossing | Tiny class 3 stream (1x1) is eroding fill remaining in incompletely pulled crossing. 589' of road drainage from the left contributes to this site. | L | 589 | 0 | 80 | ML | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission.<br>2. Install six cross road drains up left approach.<br>3. Store spoils locally against cutbank. |
| 195 | Stream crossing | 3x1 class 3 intermittent. Crossing is washed out, perhaps 70% gone. Large past diversion gully exists off of OBF. 75' down right.<br>*51 yards3 from crossing for washout. | M | 20 | 0 | 29 | M | 1. Decommission crossing. |
| 196 | Stream crossing | Pulled crossing drains springy 3x1 stream that comes down from meadow. Sides are oversteepened and raveling into stream. 468' of left approach delivers. | ML | 331 | 0 | 3 | M | 1. Lay back channel banks at 2:1 for decommission.<br>2. Add three cross road drains to left approach. |
| 197 | Stream crossing | 7x1 class 3 ephemeral, once drained by 24" CMP, is 100% washed out. Banks are laid back to 2:1 through road prism and are grassed over. Stream bed is on bed rock from top to bottom left approach, however is insloped wet and hummocky at the top of an earth flow with several odd gullies extending from OBF that intermittently carry flows. Left approach should be outsloped and cross road drains placed at regular intervals to disconnect road. | ML | 850 | 0 | | L | Install 15 XRDs to left approach |
| 198 | Stream crossing | Crossing on 7x1 class 2 intermittent is mostly gone. The stream bed is well-armored and has cut to bedrock in some locations; however the banks in the road prism are vertical and contribute directly to the stream. 600' of road approach from left is insloped with occasional, poorly constructed cross road drains. This approach should be decompacted and larger more frequent cross road drains need to be installed. Future erosion is based on approaches eroding to 1:1. | ML | 600 | 9 | 125 | ML | 1. Lay back approaches to 2:1 (approx 250 yards).<br>2. Rip 600' of left and install 15 cross road drains. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 199 | Stream crossing | Decommissioned 6x1 class 2 stream. Channel is at grade over boulder substrate. Banks are oversteepened (left bank at 38 degrees and right bank at 43 degrees). Diverted stream enters at right bank. IBR but will be treated at #200. Remaining log from Humboldt will lower excavation rate. Store spoil against C/B to left (20 cy est.). | ML | 87 | 39 | 20 | ML | 1. Lay back banks at 2:1 for decommission. Store spoil locally. |
| 200 | Stream crossing | 2x1 class 3 deposits fan onto fill crossing and diverts down both right and left sides of road. Flows now braided across road and creating series of gullies down OBF old 12" CMP in fill. Long ago plugged. | M | 0 | 0 | 55 | HM | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission. Store spoils locally against cutbanks. |
| 201 | Stream crossing | Mid-slope road with washed out stream crossing. Bed is well armored, banks are vertical and large wood is evident in the fill and channel. | M | 800 | 0 | 16 | ML | 1. Decommission crossing by excavating from top to bottom and laying backs to 2:1 through road prism.<br>2. Rip 800' of left approach and install 20 cross road drains. |
| 202 | Stream crossing | Steep 4x1 class 2 with boulder channel flows across road. Channel is at grade. Problem here is steep, soggy right bank of OBF that is saturated by emergent water from hillside above and is calving off into channel. Bank is 7' deep, 25' long and 50 degree slope. | L | 18 | 0 | 22 | ML | Lay back road bank 25'Wx2'Dx12'L = 22 cy.<br>Store spoil locally against c/b. |
| 203 | Stream crossing | 2x1 class 2 stream with banks laid back at 22% and grassy. 808' of left approach does not contribute due to cross road drains and cutbank slides. | L | 868 | 0 | | | No treat. |
| 204 | Stream crossing | Partially decommissioned 4x1 class 2 has eroded down to natural channel grade but sides are near vertical and calving into the stream. | M | 224 | 0 | 150 | M | 1. Lay back channel banks at 2:1 for decommission.<br>2. Add two cross road drains to left approach.<br>3. Store spoils locally against cutbank. |
| 205 | Stream crossing | Mid-slope road with washed crossing 400' of approach at 10% from left. Well grassed over, with 14' manzanita and madrone. Mostly insloped. | M | 400 | 0 | 26 | M | 1. Decommission crossing by excavating from top to bottom and laying back approaches 2:1.<br>2. Rip 400' of left and install ten cross road drains. |
| 206 | Stream crossing | Small 2x1 class 3 has had crossing partially pulled. Channel is now at grade, but left bank is oversteepened and calving into stream. Estimate 10 cubic yards pulled off this bank would solve problem. | L | 411 | 0 | 10 | L | 1. Excavate 10 cubic yards of material from left bank (lay back at 2:1). Store spoils locally against cutbank.<br>2. Add two cross road drains to the left. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 207 | Stream crossing | 3x1 class 3 ephemeral--washed out, save over-steepened banks through road prism. 600' of 5%, insloped road to left with 14' manzanitas on road bed. | M | 600 | 0 | 135 | ML | 1. Decommission crossing by excavation, from top to bottom and laying back banks to 2:1.<br>2. Rip 600' of left and install 15 cross road drains.<br>3. Store all spoils locally. |
| 208 | Stream crossing | Partially pulled crossing is eroding remainder of fill in crossing. 375' of left approach delivers to site. | L | 375 | 0 | 140 | ML | 1. Excavate top to bottom. Lay back channel sides at 2:1l from decommission. Store spoils against CB either side of crossing. |
| 209 | Stream crossing | Partially washed out (38 yards) fill crossing located on left hinge of earth flow. | M | 75 | 0 | 163 | M | 1. Decommission crossing.<br>2. Outslope 75' of left approach.<br>3. Store spoils locally. |
| 210 | Gully | Springy cutbank and spring flows down from very flashy steep meadow have cut 16x8x35 = 166 cubic yards erosion hole in OBF down to old haul road below. Huge landslide below lower road down into Inman Creek. Lower road has failed into Inman Creek. Sag pond on road below. Not much effective treatment options here other than radical OSR and cross road drains for the gullies down meadow. Treatment of sites up road will help as there must have been diversions to create this much carnage. FE: IS ESTIMATED FROM GULLY EXPANSION | H | 190 | 0 | 80 | HM | 2. Add five cross road drains to minimize flow concentration. |
| 211 | Landslide | Hillslope debris slide part of earth flow above, extends from road to Inman Creek. Slide is located on outside bend of Inman Creek, and has delivered thousands of yards in the past. It is currently active, with fresh 3' displacement scarps at head. A sag pond exists on left approach in the middle of the road. Water running down gully from site #211 feeds the head of the HSDS. 45'x10'250' | H | 0 | 800 | 1563 | ML | 1. Install 20 cross road drains up right. |
| 212 | Stream crossing | Stream drains onto active landslide. 7' scarp in middle of road. Big landslide feature here. Juncus and scarps festoon the hillslope. Little can be done here. | HM | 0 | 210 | | | No treat. |
| 213 | Stream crossing | 3x1 class 3 from site #207. Crossing is partially washed out. IG road just upstream (down road) from large slide complex. Past diversion gully 100' down road 10x5x150. | M | 0 | 40 | 81 | L | 1. Excavate from top to bottom and lay back to 2:1 if possible.<br>2. Pull fill on right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 214 | Stream crossing | 3x1 class 3 stream has cut meandering 3x1x50 = 6 cy gully across fill crossing. 766' of right approach. Although many cross road drains, and grassy roadbed, contributes slightly. | ML | 0 | 766 | 95 | L | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission. Store spoils locally.<br>2. Install seven cross road drains to right approach. |
| 215 | Landslide | Convergent fill slide at head of stream. Possibly a natural feature exacerbated from road fill. Stream emerges from toe. | H | 20 | 220 | 560 | HM | 1. Lower the road prism 4' by excavating 650 yds3, making the slide passable. |
| 216 | Landslide | Class 3 stream originates at OBF, road fill failure has triggered small debris torrent. Contributions from 175' of right approach of 15-15-2 and an additional ( )' from IS 15. Mostly natural feature but road drainage exacerbates problem. | M | 30 | 175 | 16 | M | Add one RD to right on 15-15-2 and two to the left on 15-15 and five to the right. |
| 217 | Gully | A spring emerges from the bottom of a small cutbank failure here. An inboard ditch has been created that holds flow for 90' until it exits roadbed across a small waterbar. A 1'x1'x30' gully runs to another roadbed below. Flow crosses roadbed and creates a 1x0.5x120' gully to class 2 below.<br>Future erosion is 100% gully enlargement. | M | 0 | 1775 | 4 | ML | Install one cross road drain at current exit point of flow and one on road bed below if possible.<br>Install 16 more up right road to intersection with Inman Creek. |
| 218 | Stream crossing | Steep stream disturbed by earthflow has caused channel to braid. Most flows divert down road at this time. 1' diameter fir at OBF will need to go. 541' of right approach with old skid with hefty gully and other sections with spring activity. Robust cross road drains to disconnect this approach. | HM | 0 | 541 | 22 | M | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission.<br>2. Install four cross road drains up right approach. Make sure spring and spur road are drained.<br>3. Use spoils to eliminate diversion potential to the left. |
| 219 | Bank erosion | A 50' stretch of outboard road is vertical and raveling into a potentially class 1 creek. The banks are 9' tall and active. The stream has scoured into one side of the fill and will continue to cut into this spot. There are several logs protruding from fill at left edge of this site. | H | 0 | 200 | 83 | HM | 1. Excavate unstable road fill between start and end flags (70'Wx9'Lx9'D). Try to get fill laid back to 2:1l. Spoil 210 cubic yards locally. |
| 220 | Stream crossing | This is an old ford crossing on the north fork of Inman Creek. It appears that there are several generations of crossings in the area but all have been pulled or washed out long ago.<br>Everything is laid back and stable. No treat here. | L | 40 | 80 | | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 221 | Stream crossing | A 3x1 class 3 stream flows across roadbed here. A pipe may have been installed shallowly here but it is long gone now. This stream converges with stream from site #222 at OBF. Both of these divert to left in fillslope for 30' and then create an 8'x8'x30' gully to class 1 below. This gully can be used for fill storage during decommission. | HM | 15 | 9 | 99 | HM | 1. Excavate from top to bottom. Give stream a 4' channel width. Spoil locally on left road. |
| 222 | Stream crossing | Fill crossings at two small creeks have been trenched so they meet at OBF and then jog diagonally down the hillslope for a while cutting a gully into class 1. This stream should be excavated through the natural channel. 206' of right approach delivers. Use spoils to bury erosion gully. | M | 0 | 206 | 232 | M | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission.<br>2. Add two cross road drains to right approach.<br>3. Store spoils locally. |
| 223 | Stream crossing | 3x1 class 2 stream meanders its way across a large landing, finds its way into a low gradient thru-cut, back across more low gradient landing and then down erosion gully (30Lx8Dx12W = 107 cy DE.) This gully is mostly stable, but not totally (~10% left). May be best to cut channel and cross narrow part of landing down to stream. | ML | 530 | 200 | 808 | ML | 1. Excavate top to bottom. Place spoil to right of new excavation to prevent diversion. Lay back sides at 2:1 for decommission.<br>2. Add four cross road drains to the left and one to the right. Store spoils on landing. |
| 224 | Stream crossing | A 3x1 class 3 stream flows across road here. Crossing has been partially pulled. Channel is nearly at grade through crossing. A large bedrock shelf at bottom prevents any further incision. Banks are oversteepened and active at OBF. These should be pulled back. | ML | 120 | 385 | 41 | ML | 1. Give stream a 4' channel between top and bottom. Bottom is on large bedrock shelf and channel is nearly at grade so laying back banks 2:1 is the job here.<br>2. Spoil locally on road.<br>3. Install four cross road drains right and one to left. |
| 225 | Stream crossing | A 2x1 class 3 stream has had 95% of its fill pulled. The banks are well laid back and only very minor gullying across fill remains. Future erosion very minor and not worth worrying about. Right approach is long, however, and cross road drains in place are old and eroding. | L | 13 | 875 | 1 | L | 1. Install 8 cross road drains to right approach. |
| 226 | Stream crossing | Small class 2 stream has been decommissioned but saturated soils from landing above have caused right bank of stream to slump into channel. Flows are eroding the toe of this block. Right bank at OBF is oversteepened and should be excavated. Lots of storage for spoils available locally. | HM | 60 | 0 | 61 | HM | 1. Excavate slumped material (55 cubic yards). Also remove 6 cubic yards at OBF of oversteepened right bank. Store spoils locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 227 | Stream crossing | Two parallel streams (right hand stream probably has origins as a skid). The more natural of the two is diverted 60' to the right by berm at OBF. Little erosion here (channel incision below road at site #229 ~15 cy). | L | 0 | 10 | 8 | ML | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission. Store spoils locally. |
| 228 | Stream crossing | A low gradient 6x1 class 2 stream flows across a broad ford. A broad landing has been placed in this wide swale to the right of this stream. Channel is at grade throughout crossing. Just below the ford crossing the stream begins to cut into landing fill. Also, a log in channel forces flow against right bank of landing fill. Future erosion is minimal. Road approaches are densely grassed and stable. | L | 5 | 130 | 15 | L | Excavate unstable fill below road on right bank. Start and stop flags are hung (50x4x4 = 30 cy). Spoil locally on landing to right. Also remove two 2' diameter logs from channel next to bank erosion. |
| 229 | Stream crossing | No fill in this crossing. Treatment of #227 will fix any problems here. | L | 60 | 20 | | | No treat. |
| 230 | Stream crossing | A 3x1 class 3 stream flows across road fill here. Site is located just off of IS 17 on south side of crossing at site #231 (see sketch). Flow drops 12', almost vertically, into class 1 north fork of Inman. Banks here are high and active. Decommissioning this site will alleviate most of this section of unstable banks on north fork of Inman. | HM | 25 | 45 | 80 | HM | 1. Excavate from top to bottom (bottom is in north fork of Inman). Give channel 4' width. Lay back banks 2:1. Spoil locally. |
| 231 | Stream crossing | This old ford crossing has a log jam 75' downstream. Flows have eroded below it and mobilized sed retained behind the jam. This causes the ford to display 2'-3' vertical banks. Both approaches are 10% and well grassed over. | ML | 114 | 20 | 17 | L | 1. Lay back both approaches at 30'Wx1'Dx15'L = 17 cy for a total of 34 cy, excavated. 2. Store spoils locally. 3. Add two cross road drains to right approach. |
| 232 | Stream crossing | This is a small 2x1 class 3 flowing across road bed. Road bed is old and hummocky. There is slight DP to left. Below road is damp and grassy, flood terrace. Area is wide and hummocky and must only see north fork of Inman flows during extreme rain events. All road fines from this stream filter out quickly in grass. Only 25% will ever deliver to swollen Inman. | L | 0 | 5 | 13 | L | 1. Excavate top to bottom. Give 4' channel width. Lay back banks to 2:1. Spoil locally. |
| 233 | Stream crossing | Ford crossing of 4x1 class 3 low gradient stream. 160' of low gradient left approach is the only problem with this stream terrace setting. There is no fill in this crossing. | L | 160 | 48 | | L | 1. Add one cross road drain on left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 234 | Stream crossing | 4x1 class 3 stream has incised channel through road fill, stream terrace into Inman Creek. Channel is uniformly 4' deep and 4' wide and meanders across road and terrace (Inman Creek exhibits the same vertical banks). Banks are vegged except on outside bends and no treatment may be the prudent option here, but will call for laying back channel walls. | ML | 48 | 0 | 110 | ML | Excavate channel banks at 2:1 (186x4x8 = 220 cy). |
| 235 | Stream crossing | A 6x1 class 2 stream has been cutting through fill here for a long time. 4'x6' vertical banks are active throughout site. Channel is at grade and future erosion will likely be a result of bank erosion. Site begins ~50' above road bed at large bedrock in channel (see sketch). An average 7' deep channel has been cut through road fill and landing area/terrace. No DP. Bottom is at confluence at north fork Inman Creek. | HM | 60 | 0 | 217 | M | 1. Excavate from top to bottom with 6' channel width. Lay back banks 2:1. Spoil locally. |
| 236 | Stream crossing | Decommissioned crossing is at grade, sides laid back nicely 1' deep vertical walls through crossing. No delivery from approaches. | L | 65 | 50 | 3 | | No treat. |
| 237 | Stream crossing | 3x1 class 2 stream has had crossing pulled. Didn't get all the way to grade on outboard side of excavation and flows have down cut 2' to base of fill. Banks are laid back okay and grassed over and okay. 310' of right approach delivers slightly. | L | 30 | 310 | 32 | L | 1. Excavate channel walls at 2:1 for decommission. Store spoils locally. Give 4' channel width.<br>2. Add two cross road drains up right approach. |
| 238 | Stream crossing | A 4x1 class 2 stream has had 50% of its fill pulled in the past. Evidence is in the piles of fill to left and right of crossing. Stream has since eroded deeper into fill until channel is at grade and banks are nearly vertical again. Future erosion is from failing banks. | HM | 15 | 10 | 28 | M | 1. Pull back steep banks between top and bottom. Lay back to 2:1. Spoil locally on road bed. Make sure channel has 4' width through crossing. |
| 239 | Stream crossing | Tiny class 3 stream crossing has been 50% pulled with deep cross road drain that has outlet 20' to left of natural channel. Sediments aggrade in low gradient cross road drains. May be best to not treat this site. 150' of right approach has a cutbank slide that is well vegged and delivered very little. | L | 0 | 150 | 24 | L | 1. Excavate top to bottom. Lay back sides at 2:1 for decommission. Use spoil to bury misaligned decommissioned channel.<br>2. Add one cross road drain to right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 240 | Stream crossing | A 2x1 class 3 stream has had ~40% of fill pulled from the crossing. Fill is stored in two piles on either side of crossing. Stream has further incised 3'-4' into crossing leaving oversteepened banks. This was likely a Humboldt crossing. There are logs piled in old fill heaps and one still lies in channel parallel to flow. | M | 0 | 330 | 46 | ML | 1. Excavate from top to bottom. Give a 4' channel width. Remove any logs from fill. Lay back banks 2:1. Spoil locally left side may be too close to native hillslope to lay back 2:1. Right side can go back.<br>2. Install four cross road drains to right road. |
| 241 | Stream crossing | 4x1 class 2 stream crossing has been pulled. Oversteepened lobe of material at right bank of OBF is all the fill that remains. Crossing is completely overgrown with whitethorn and downed trees making cross sections impossible but channel is at grade. Estimate perched material to be 24Lx3Dx16'W = 43 cy. | L | 0 | 150 | 43 | L | 1. Excavate 43 cy of material from right side of OBF. Store locally.<br>2. Add two cross road drains to the right. |
| 242 | Stream crossing | A 4x1 class 3 stream flows though a partially pulled crossing. Approximately 40% of the fill lies in storage near the crossing. Stream flow has since incised 3'-5' through the rest of the fill leaving oversteepened banks. There is some raveling happening on steep banks at OBF but most of it is mossy and stable. A very small streamlet in a non-natural channel reaches this stream from right just at IBR. No problem. | M | 10 | 25 | 10 | ML | 1. Excavate top to bottom. Give stream 4' channel through crossing. Lay back banks 2:1. Spoil locally. |
| 243 | Stream crossing | Very difficult site to treat as the sediment to be saved is 30'-80' down the steep channel retained by buried legs. Most of this sediment is from the left approach failing into the stream. What remains of the left approach supports a cutbank slide that wouldn't respond well to excavation. Although oversteepened it is vegged and mossed over. | ML | 0 | 60 | | | No treat. |
| 244 | Stream crossing | A 2x1 class 3 stream flows through a 90% pulled crossing. Spoil is stored on roadbed at both sides. Flow has cut 1'-1.5' further into fill but banks are very laid back (beyond 2:1) and stable. 1' diameter fir trees and 2'-4' diameter whitethorn are already populating the area. Approaches are hummocky and grassy. No treat. Future erosion is from bank collapse through crossing. | L | 45 | 120 | 5 | | No treat. |
| 245 | Stream crossing | Decommissioned crossing of small stream. Channel is at grade and mossy. Flows drain down to stream terrace/landing and go subsurface. 440' of 28% right approach has robust cross road drains every 75'. | L | 0 | 440 | | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 246 | Stream crossing | Small but very steep 2' x .5 class 3 stream crossing has been partially pulled by trenching across the road. There are gullies and little head cuts @ the outboard fill. 185' of right approach delivers to the site. | L | 0 | 185 | 59 | ML | 1. Excavate TOP to BOT. Lay back channel sides @ 2:1 for decommission. Store the spoil locally against the cutbank.<br>2. Install 1 cross road drain up the right approach. |
| 247 | Stream crossing | Small 3' x 1' class 3 stream has been partially decommissioned by trenching across the road and placing the removed material on the downhill side. Flows will continue to down cut thru the road fill. 340' of steep right approach delivers. | ML | 0 | 340 | 100 | ML | 1. Excavate from TOP to BOT. Lay back channel sides @ 2: 1 for decommission. Store the spoil locally against the cutbank.<br>2. Install 3 cross road drains up the right approach. |
| 248 | Stream crossing | A 6' x 1' class 2 stream flows thru a partially pulled fill crossing. The fill has quite a bit of depth at the out board fill but is being supported by two 2.5' - 3' diameter logs perched in the fill parallel to the stream flow. Although the channel is well armored, once logs fail the crossing will erode. 800' of right road connects to stream. | HM | 6 | 800 | 71 | M | 1. Excavate from TOP to BOT. Give 6' channel width. Lay back banks @ 2:1 Spoil locally. Remove large woody debris at the outboard fill.<br>2. Install 8 cross road drains to the right. |
| 249 | Landslide | This is a large past landslide. This was a wide (80'), planar, transitional slide that has pushed 6x1 class 2 stream from site #248 to the far side of the canyon. Slide was approximately 80'Wx20'Lx6'D. 90% of this site looks stable in deposit below while stream at far side of valley cuts through low gradient toe of deposit. Slide face is grassy and stable. No treat.<br>This site is a factor when considering access to #248. | L | 120 | 110 | | | No treat. |
| 250 | Stream crossing | A small 2' x 1' class 3 stream has had 80 % of the road fill pulled from the crossing. The channel above the road has been tractored. Future erosion here is very minimal. Small banks are steep but mossy and stable. The stream does not see much flow. Very low immediacy. The channel is at grade thru the crossing. | L | 120 | 0 | 5 | L | 1. Pull back small amount of unstable fill alongside the stream. Excavate the channel to a 4' width. |
| 251 | Stream crossing | This crossing has been 95% pulled. A 5x1 class 2 is at grade through crossing. Channel is well armored. Right bank is well laid back at 20 degrees. Left bank is well laid back at IBR but a lobe threatens to fail at OBR. Remove this remaining fill and decommission will be complete. | L | 70 | 20 | 18 | L | 1. Excavate 20'Wx12'Lx2'D + 18 cubic yards of OBF on left bank. Spoil locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 252 | Stream crossing | This is a near source 2' x .5' class 3 stream. The fill has been partially pulled and placed at the right hinge line. ~ 4 c.y. of 1'--2' rocks have been placed at the outboard fill and are working to armor the fill. | L | 400 | 4 | 13 | L | 1. Excavate from TOP to BOT. Give a 4' channel width. Lay back the channel banks to 2: 1. Store spoils locally.<br>2. Add 4 cross road drains to the left. |
| 253 | Stream crossing | This is a ford crossing on the main stem of Inman Creek. The confluence with north fork Inman is just 100' upstream. Both banks are stable and laid back. Both approaches are grassy and well-drained. No problem. No treat. | L | 25 | 100 | | | No treat. |
| 254 | Stream crossing | A near-source 2x1 class 3 crosses road here 95% of fill has been pulled and placed at lower (left) hingeline. Stream has already eroded any fill that was left here so channel is at grade throughout. Channel and fill is full of huge mossy boulders. Left bank is 3' tall and steep but totally mossy, rocky, and stable. Road is grassy and well cross road drained. Stream is diverted slightly above road to this spot (see sketch) but situation is stable and not worth creating a huge hole to fix. | L | 6 | 85 | 5 | | No treat. |
| 255 | Stream crossing | Pulled crossing of a 6x2 class 2 stream. Banks are laid back at 2:1 and well-vegged. Boulder/bedrock channel. Appears that a bridge was here at one time, several 3'x4'x2' concrete blocks are in vicinity of site. This is a steep frequently crossed road. No fill remains in this crossing. | L | 70 | 280 | | | No treat. |
| 256 | Stream crossing | A 2' x 1' class 3 stream has essentially lost its channel. The entire swale here is unstable. The surface is hummocky and has turned the stream into a broad springy area. The cutbank and road is covered with hydrophilic vegetation for ~ 100'. A 2' x 1' gully is being cut across the road at the lower hinge of the springy area. This is where the site is focused and treatment is recommended. The channel is extremely mossy and low gradient. Future erosion is minimal. | ML | 0 | 850 | 29 | L | 1. Excavate from TOP to BOT. Give 4' channel width. Lay back the banks to 2:1. Place spoil on the left hinge line to prevent future diversion.<br>2. Install 8 cross road drains to the right. |
| 256.1 | Gully | This site is the last of a series of water bars at the bottom of I. S.-16 and has formed a gully at the cross road drain outfall into Inman Creek. Future erosion is based on 100% gully enlargement. | ML | 480 | 0 | 10 | ML | 1. Install 5 cross road drains up the left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 257 | Stream crossing | Decommissioned crossing. Road fill slopes coming into crossing are near 2:1 and dense with grasses as well as road bed outside of crossing. Stream has incised about 2ft into fill but no failures have occurred on either bank. Crossing looks stable. Bedrock outcrop at BOT produces a 12ft drop down to natural channel. | L | 40 | 55 | 2 | | No Treat |
| 258 | Stream crossing | Partially decommissioned crossing. Flows have cut down to bedrock in channel but banks are oversteepened and calving into channel. Faint road just below this one but crossing is down to bedrock and very little remaining except for 10cy of oversteepened right bank. | M | 150 | 0 | 3 | ML | 1) Excavate crossing from TOP to BOT with 4ft channel width. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) Remove 10cy of material from right bank on lower road. |
| 259 | Landslide | This site is a large deep-seated landslide. The majority of the road fill, as well as the roadbed, has eroded through the width of the feature. 1'-2' vertical scarps exist along the lateral edges as well as above the cutbank. Movement of the hillside looks also to be influenced by being located on an outside meander of Inman Creek. The slide feature width is basically from stream crossing site # 258 and # 260, about 360', but the future width will be of remaining roadbed. Future erosion is the road fill only. | HM | 0 | 0 | 100 | L | 1. Excavate remaining road fill from start to end flags: 150 x 4 x 10 = 267cy 2. Endhaul spoil down both left and right roads (roadbed is gone between both hingelines). |
| 260 | Stream crossing | Decommissioned crossing. Left bank is oversteepened and calving into stream. Right bank is vegged and stable but at 37% slope. Channel has down cut 1ft and appears stable. Little to no contribution from either road approaches. Channel is slumping at inboard fill but negligible elsewhere. | ML | 150 | 60 | 39 | ML | 1) Excavate crossing from TOP to BOT with 4ft channel width. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) Install 1 XRD up left road. |
| 261 | Stream crossing | Actively headcutting fill crossing on landing in middle of stream. Road bed is very diffuse here. Site is in Redwood forest that borders grassland. Stream channel above landing was skidded. From TOP flag, at present head cut, down channel to end of landing stream has ricochet form bank to bank and is actively eroding fillslopes. Stream channel below landing looks relatively stable. Road beds contributing to site are well vegged and don't require XRD's. *Check site = this entire fill could be a landing or ancient toe of a landslide, but the amount of stumps and cut logs indicates that this was a landing of sorts. | HM | 230 | 300 | 322 | HM | 1) Excavate crossing from TOP to BOT with 4ft channel width. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) Layback head cut to 2:1 and armor with 20cy of 2-3ft rock to stabilize fill material in channel above TOP flag. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 262 | Gully | This site is a waterbar that receives 510' of road/ditch flow from Slippery Slope Road, which has been heavily cross road drained, but if this ditch still carries flows they will deliver to a headwall swale. The road is too steep for rolling dips and quite springy at the top of the reach. The roads in this area have been put to bed and are very brushy and would appear to be better left so. The ditch is inactive and has vegetated banks and the bottom is filled with duff. Future erosion is based on 25% inboard ditch enlargement. | L | 0 | 510 | 38 | L | 1. Outslope road - keep ditch for 510' up Slippery Slope Road.<br>2. Install 4 18" x 30' ditch relief culverts up this reach. |
| 263 | Stream crossing | Small flashy class II stream crossing. Stream barely noticeable above road. No definable stream valley. Downed tree across road where flow crosses road. Road fill is too shallow here to install a culvert and provide a critical dip. Low probability this stream is connected to any class l down slope. | L | 0 | 250 | 10 | L | 1) Install an armored fill crossing using 10cy of rock armor. 2) Rock roadbed thru crossing. 3) Install 1 rolling dip and one 18" by 40' DRC up right road reach. 4) Outslope road and retain ditch for 250ft. |
| 264 | Stream crossing | This is a pulled crossing on a 4x1 class 2 stream. It appears the pipe that was removed was not installed in the axis. This has left a meander in the channel below. The channel should be defined through this. Below the Humboldt is a large scour hole with lots of LWD imbedded in right bank. To remove this would destabilize this bank and doesn't seem feasible, but the left bank is actively failing and should be relieved (30'w x 15'l x 4'd = 67cy). True BOT may be ~100' down the channel and excavating may be considered. Two streams up the left approach divert at times to this crossing. Treatment of these sites will eliminate additional incision here. Pipe doesn't need to extend to BOT if channel is defined below crossing. 60' shall do. | M | 135 | 140 | 283 | M | 1. Excavate from TOP to BOT. Install 30" x 100' CMP in axis at grade. Raise road ~2 to accommodate CMP.<br>2. Define channel below crossing.<br>3. Excavate 67cy of material from left bank of erosion hole below crossing.<br>4. OSR-KD 140' to the right.<br>5. Install 18" x 30' DRC to the right.<br>6. Create 1 RD to left approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 265 | Stream crossing | Grassy wide shallow bowl where four class 3 streams converge. The two streams to the left mostly deposit sediment load in oak trees and then saturate road bed below. The middle stream, the largest of the four, meanders across road bed (saturating road) and then continues on in its natural stream channel below road. Stream furthest to the right is currently diverted down to stream at site #264. Road bed is densely vegetated with juncus down to site #264. Some LWD near BOT. | L | 60 | 0 | 7 | M | 1. Use excavator and dozer to bowl out hillslope above road and define stream channels down inlet of new culvert.<br>2. Excavate road bed from TOP to BOT to install a 30" x 40' CMP at base of fill.<br>3. Stock pile spoils to left on grassy hill.<br>4. Use spoils to berm up right road to prevent diversion.<br>5. Pull back right bank to 2:1 for 40' below BOT. |
| 266 | Stream crossing | Wet swale in grassland setting. Conifer and oak woodland below road with well defined class III stream. What was once ground water flow from grassland above road has saturated road fill and washed out majority of road bed. Road fill on both left and right hinge lines are near vertical and are calving away. Slump will continue to migrate up hillslope. | HM | 0 | 300 | 29 | ML | 1) Excavate crossing from TOP to BOT to install a 24in by 40ft long culvert at channel grade. 2) Lay back headcut above IBR and armor with 5cy of 2-3ft rock. 3) Dip road thru crossing to prevent diversion potential. 4) Outslope and retain ditch for 300ft up right road. 5) Install 2 rolling dips and two 18in by 40ft long DRCs. |
| 267 | Landslide | The road surface has failed down the hillslope. The site is part of a much larger deep-seated feature. The site exhibits 6' lateral scarps and 4' head scarp. The right side of the slide ends 50' above the stream at Site # 266. There is a grassland /headwall swale above. Excavate remaining road fill to unload the top of the slide. | M | 0 | 0 | 88 | M | 1. Excavate remaining 350 cy of road fill. Store spoils locally. |
| 268 | Stream crossing | The site is a tiny 1' x 1' class 3 stream with a pulled fill crossing. The channel is down cut ~1' through the crossing. - Shallow fills- The short approaches are grassed over with little contribution. The hillside above was tractored. | L | 180 | 80 | 27 | L | 1 Excavate TOP to BOT. Lay back channel walls at 2:1 for decommission. Store spoils on the right approach to prevent diversion.<br>2. Install 1 cross road drain up the left road. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 269 | Stream crossing | The site is a small partially pulled crossing. There is a 6' high bedrock outcrop at the cutbank/headwall at the inboard road in the channel. The stream looks to be slowly headcutting into the road fill from the outboard road though moderately naturally armored with 1' rocks. Small berms exist on either hinge line of the crossing. | ML | 0 | 135 | 10 | L | 1 Excavate crossing from TOP to BOT to 4' channel width, lay back channel sides at 2:1 for decommission. Spoil locally.<br>2. Install 1 cross road drain to the right. |
| 270 | Stream crossing | This site is a pulled stream crossing. The stream looks to be at grade through the crossing with a wide enough channel. Some fill was left above the inboard road along the right bank. The fill face to the channel is near vertical, about 5' high and mossy. There are no signs of recent cracking or slumping. The outboard fill on the right bank has one Humboldt log remaining and the stream looks to be actively eroding the fill ( ~30 cy future erosion ) The channel the outboard fill has 6'-10' rock with 2 sections of culvert. Rill/gully coming down excavated fill face at inboard road from the right approach.<br>475' of right road is grassy and springy along the inboard ditch. | L | 0 | 475 | 96 | L | 1. Pull the remaining fill along the right bank above and below the road.<br>2. Install 6 cross road drains up the right approach. |
| 271 | Stream crossing | A 4' x 1' class 3 stream meanders across this landing. Channel is incised but the sides are mossy for the most part and stable. Spoil has been piled up to the left of the crossing to prevent diversion. The stream has a boulder/cobble channel that appears stable. The stream flows to a bench area below. The left approach is wet and dense with Juncus. | L | 40 | 246 | 10 | | NO TREAT |
| 272 | Landslide | Past landslide area in springy swale. Inboard ditch, as well as hillslope, above road is dense with Juncus and bunch grasses. Hillslope beyond Outboard road looks to have at least two slump terraces with small conifers growing on them. Trees on slumps look relatively straight. No cracks observed along outboard road, but wet inboard ditch suggests potential future erosion. Inboard ditch and cutbank are being drained by a cross road drain at right hingeline, hence the low treatment immediacy. | ML | 0 | 100 | 38 | L | 1)Excavate along outboard road from Start to End flags (115x2x15). 2) Outslope road back to cutbank to drain springy hillslope. 3) Spoil locally. 4) Install 1 cross road drain up right road. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 273 | Stream crossing | Partially decommissioned crossing. Crossing looks good except for the Humboldt logs remaining at base of fill. These logs are now buttressing fillslopes and are constricting natural channel width. Smaller stream (site#274) confluences this stream at outboard road. There is sediment below this confluence that is retained by a root wad. Left road approach is rilled and contributes sediment to this site. | ML | 236 | 24 | 89 | ML | 1) Excavate crossing from TOP to BOT with 5ft channel width, removing Humboldt logs and root wad. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. |
| 274 | Stream crossing | Decommissioned crossing. Bedrock channel at middle of road. Some fill remaining along left bank from Middle of road to confluence with flow from site# 273. See sketch. Right road has water bars and is fully grassed over. | L | 0 | 250 | 5 | | No Treat. |
| 275 | Stream crossing | Decommissioned crossing. One Humboldt log remains at base of fill on left bank at channel bottom at outboard road. Area looks very stable. Slopes laid back 2:1. Right road reach is water barred and grassed over. | L | 0 | 190 | 2 | | No Treat |
| 276 | Stream crossing | Pulled or washed out crossing on Inman Creek. Only evidence of crossing is the presence of about 10 cut logs lying, half buried, parallel to flow to right of present thalweg. Lots of 2-4" steel head fish present. Crossing is just down stream from confluence with major tributary coming from the east. | L | 0 | 80 | 0 | | No Treat |
| 277 | Stream crossing | Partially decommissioned crossing. Inboard side of crossing aggrades and allows flow to divert down inboard road due to shallow excavation. 3ft head cut at outboard road. Stream out falls onto bedrock channel below. | L | 180 | 0 | 40 | L | 1) Excavate crossing from TOP to BOT with 4ft channel width. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally along right hinge line to prevent diversion. 4) Install 2 XRDs up left road. |
| 278 | Landslide | A combination of springy road/cutbank and active scour downslope by Inman Creek has caused a cutbank failure and outboard failure of road. Presently a lobe of cutbank material is on roadbed. OBF and hillslope below have failed down to creek. Large maple and small madrone and firs are growing in evacuated area. Small gully on right hinge line of feature is draining majority of spring flow. | L | 0 | 60 | 53 | L | 1) Excavate remaining road fill from START to END flags plus lump of cutbank material presently on roadbed. 2) Outslope roadbed to transport spring flow. 3) Spoil locally. |
| 279 | Stream crossing | Decommissioned crossing. Fill material stockpiled on both sides of crossing. Humboldt logs stockpiled on right road reach. Fill slopes laid back >2:1, dense with grasses, and some small trees. | L | 0 | 0 | 0 | | No Treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 280 | Stream crossing | Mostly road bed has been bermed on both sides of crossing as a sort of decommission measure. Sediments are aggrading on road bed. Over time aggradation may cause stream to divert. | L | 0 | 0 | 17 | L | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. |
| 281 | Landslide | The majority of the roadbed has already failed into Inman Creek. About a 2' wide section exists along the cutbank for the first 100' then roadbed width varies up to the right hingeline. The failure looks to have been caused by Inman Creek. The road was built in inner gorge setting, just above (40' horizontal ) Inman Creek. Long sections of the cutbank are rock outcrops. | M | 60 | 0 | 130 | | No TREAT |
| 282 | Landslide | This site is a hillslope debris slide on an outside bend of Inman Creek that has removed about the majority of the fill from the road. All that essentially remains is a notch cut in the bedrock, 10' wide from undercut bedrock cutbank to road outboard edge that is also bedrock. A stump in the middle of the future retains a little fill. There is no room to cut the road deeper into the bank. Soil and rubble has failed onto the roadbed from above. This is a bad place for a road. The road bed is not wide enough to get equipment into. | ML | 0 | 230 | 22 | | NO TREAT |
| 283 | Stream crossing | This stream looks more gully like above the road. The stream crosses upper road (Site # 284) before hitting this road. The stream comes down an 8' cutbank and diverts down the left road where it deposits its bed load and saturates into the road bed, there is no definable natural channel below. Very little morphology where the flow exits the road except for a few shallow old cracks along the outboard road. | L | 0 | 100 | 7 | ML | 1. Define a channel across the roadbed from the cutbank down to the base of the fill to capture stream flow and transport it across the road. |
| 284 | Stream crossing | This is a pulled stream crossing on a spur road just above Site # 283. (See sketch on Site # 283). Excavated area looks stable. The stream is at grade. The stream looks more gully like above the road. There is no stream valley. | L | 80 | 0 | 0 | | NO TREAT |
| 285 | Stream crossing | This crossing has been about 70% pulled. The fill slopes are oversteepened and the channel looks constricted. A 4' diameter log (above the crossing) in the channel is causing (at high flows) some of the water to divert onto the roadbed and gully down the right fillslope back into the channel. | ML | 0 | 70 | 37 | L | 1. Remove the log from above the crossing.<br>2. Excavate the fillslopes through the crossing back to 2:1. Spoil locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 286 | Stream crossing | This site is a pulled stream crossing of a class 2 stream. The banks are mossy and vegetated and well laid back. ( See site #287 for sketch ) This site is at lower end of site # 287 on older roadbed. | L | 60 | 0 | 0 | | NO TREAT |
| 287 | Spring | Spring flow emanating from the cutbank here. There is no channel morphology above the road. This spring develops into a class 2 stream down to Site #288 and then into Inman Creek. The roadbed has been pulled back around the springy area and appears stable. This spring looks to produce a lot of flow during the wet season. | L | 40 | 0 | 0 | | NO TREAT |
| 288 | Stream crossing | Spring flows originate on the hillside above the upper road. They run down the inboard ditch on the lower road to exit the outboard fill creating a gully that runs under a massive fallen Redwood stump /root wad. The gully is laid back to 2:1 and for the most part stable. | ML | 40 | 90 | 18 | L | 1. Excavate TOP to BOT. Store spoil locally. |
| 289 | Stream crossing | This site is a partially excavated crossing. It looks as though the crossing was slightly dipped and the material was used to build up a berm along the left hingeline. Sediment is aggrading through the road prism. A skid road above (parallel to the road) diverts and bifurcates flow. It's difficult to determine where the natural channel was below the road. Part of the diverted flow drops down the 4' cutbank and deposits sediment on the road 30' from the present crossing. The present channel below the road is incised but well armored with native rock. Moderate-low treatment immediacy because the end result will still keep flow in the current channel. The treatment is prescribed to minimize the occurrence of sediment deposition. | ML | 0 | 45 | 24 | ML | 1. Walk equipment up the skid to where flow is bifurcating and define the channel and build berm down to the TOP flag.<br>2. Excavate crossing from TOP to BOT at a more natural channel grade.<br>3. Spoil locally. |
| 290 | Stream crossing | A small class 3 stream bifurcates above the road. The crossing has been well pulled The banks are well vegetated and stable. No fill remains in the crossing. The flows dissipate on a road /bench below with no erosion down to a class 1 stream. The stream is split above the road by a small slump block. | L | 0 | 50 | 0 | | NO TREAT |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 291 | Stream crossing | This site is a pulled crossing just below the confluence of 2 6' x 1' streams. The channels above are choked with cut large woody debris and both look incised. The fillslopes through the crossing appear oversteepened, but with native rock exposed throughout. An 8" flex pipe remains in the channel. BOT of the excavation is constricted by an overturned stump on the left bank and large woody debris protruding from the fill on the right. The channel opens up beyond BOT with very little large woody debris. The excavated fillslope along the left hingeline looks springy. It may have saturated and slumped into the stream post excavation. There is a stump with basal flare on the left bank near the inboard road. | M | 0 | 150 | 110 | ML | 1. Excavate the crossing from TOP to BOT with a 6' channel width and lay back side slopes to 2:1. Spoil locally.<br>2. Install 2 cross road drains up the right road. |
| 292 | Stream crossing | This site is a low gradient, low power 2' x 1' class 3 stream. The crossing has been pulled with little fill remaining. The right is well drained with large cross road drains frequently spaced. | L | 0 | 260 | 11 | L | 1. Excavate the crossing from TOP to BOT. Give the channel 3' width and lay back side slopes at 2: 1. Spoil locally. |
| 293 | Stream crossing | Fill crossing in which the stream has diverted down the inboard road for roughly 200'. The stream has incised about 8'. The gully bottom is rocky and appears to be close to relative channel grade. The stream is presently flowing into Inman Creek and most likely has fish in it. The crossing is on a short spur road on the upstream end of a landing. The spur extends down to Inman Creek. | ML | 0 | 0 | 89 | HM | 1. Excavate the crossing from TOP to BOT with a 6' channel width at grade.<br>2. Lay back side slopes at 2:1. Spoil locally. |
| 294 | Stream crossing | This site is a partially pulled crossing. There is a 4' knick point at the TOP of the excavation formed by the remaining Humboldt log in the fill and other large woody debris. The entire channel above the crossing is littered with large woody debris, so the had to stop excavating somewhere. The stream looks to be at grade from TOP past BOT down to class 1 stream. The fillslopes through the crossing are not laid back to 2:1 and the channel width constricts the flow. The fillslope looks to be eroding (at a slow rate) by the deflection of the flow through the crossing. | ML | 40 | 100 | 38 | L | 1. Widen the channel through the crossing to 5'.<br>2. Lay back side slopes to 2:1. Spoil locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 295 | Stream crossing | This is a pulled crossing on a major tributary to Inman Creek. The only way we could tell that a crossing was here is by road prism on left bank (see sketch). Some cut large woody debris scattered in the channel may be remains of old crossing, but large woody debris exists in the channel above and below the crossing. Existing roads are roughly 5' above active channel. If this road is upgraded, a ford crossing could be installed depending on season and type of use. | L | 50 | 80 | 0 | | NO TREAT |
| 296 | Stream crossing | A 3' x 1' class 3 stream flows across a low gradient landing. The channel bottom is very rocky, but the side slopes are vertical. A gully down the skid to the left drains to the crossing. The outboard edge of the landing has failed into a large woody debris choked, possibly class 1 stream. It does not appear to be easy to excavate this site due to the large woody debris. | ML | 150 | 0 | 67 | L | 1. Excavate TOP to BOT. Lay back side slopes at 2:1. Place spoil on the right hingeline to prevent diversion. 2. Install 3 cross road drains up the skid to the left. |
| 297 | Stream crossing | This site is a pulled crossing of a 4' x 1' class 3 stream. The channel walls are vertical in places and flows have cut vertical bank on the right hingeline where a spoil pile deflects flows. A 1' diameter brow log buried in the outboard fill retains boulder/cobbles in the channel resulting in a scour hole below. The stream crosses the road on a diagonal and would be fairly easy to straighten. | ML | 75 | 0 | 42 | L | 1. Excavate TOP to BOT. Lay back side slopes @ 2:1. Remove the brow log and large rotted log with 20 cy of material 10' beyond to eliminate scour. Store the spoil on the landing 75' to the left |
| 298 | Stream crossing | Grassland setting. Supposedly there was a road and a crossing here as indicated on Map 2. But no road morphology or any sign of crossing presently. The only reason this one was written up is because it is indicated as a crossing on the map. | L | 0 | 0 | 0 | | No Treat. |
| 299 | Stream crossing | Decommissioned stream crossing. Stream channel was skidded above road. Knick point of fill above TOP is well armored with 2-3ft rock. Slopes are laid back 2:1. Channel has incised 1-2ft thru fill and looks to have stabilized. Rock to left of TOP has a “10” spray painted on it. | L | 60 | 50 | 3 | | No treat. |
| 300 | Stream crossing | Tiny stream crossing. Skid road up channel from road. Crossing has been decommissioned, but some fill remains. Channel is stable with little incision. 180ft of left approach has robust XRDs and does not deliver to site. | L | 180 | 0 | 27 | L | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. |

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| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 301 | Stream crossing | Partially decommissioned crossing. Area thru roadbed looks stable and properly done. Two streams confluence above TOP. At stream to the left, skid fill (that crosses channel) was left and stream has incised thru fill. Fill slopes are near vertical. No cracks observed. Fill faces are mossy, but knick point exists at base of skid fill indicating channel will continue to erode fill. | ML | 50 | 30 | 25 | L | 1) Excavate remaining skid fill from START to END flags laying slope back to 2:1 where possible. 2) Spoil locally. |
| 302 | Stream crossing | Partially decommissioned crossing. Stream at natural channel grade. A lobe of fill exists on right bank at outboard road. Channel walls are vegged with fir trees. Road approaches do not deliver to site because of XRDs. XRDs are delivering to class II stream below via their outlets. | L | 275 | 0 | 13 | L | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) Add 5 XRDs up left road to disperse flow. |
| 303 | Stream crossing | Partially decommissioned crossing. Road looks to have been just dipped thru crossing. Sediments coming down channel are aggrading on roadbed. Stream is actively head cutting from BOT up to outboard road and will continue to do so, slowly, over time. | ML | 175 | 0 | 40 | ML | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) Install 2 XRDs up left road. |
| 304 | Stream crossing | Partially washed out fill crossing that appears to be across small landing. Road approaches do not deliver. | M | 20 | 30 | 35 | ML | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. |
| 305 | Stream crossing | Skid off of the road. Not sure where road ends here. So many skids coming down hillside. Stream channel has been skidded as well. Stream has incised thru skid fill (2-3ft depth) up channel. Area thru road looks the same as channel above road, hence no treat. | ML | 60 | 0 | 5 | | No treat. |
| 306 | Stream crossing | Pulled stream crossing on main tributary. To Inman Creek. Slopes are laid back 2:1 but stream was not excavated down to natural channel grade. A 3ft head cut exists just above BOT. Left bank of outboard road for 40ft has cracks up to 15ft back into roadbed. Cracks do not show much vertical displacement but look relatively new, indicating recent movement. As head cut migrates up channel it may further destabilize OBF along left bank. Future erosion is stream profile plus failing outboard road along left bank. | HM | 60 | 0 | 209 | HM | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Pull back failing OBF along left bank (40x7x15). 4) Spoil locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 307 | Stream crossing | Steep flashy stream is partially pulled. Flows have triggered outboard fill failure probably helped by spring flow as well. Lots of old rotting logs perpendicular to crossing suggesting old brow logs. Bedrock in crossing so headcutting may be minimal. | HM | 70 | 30 | 48 | M | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. 4) May need to excavate an additional 40cy to influence spring flow on left hinge line into channel. |
| 308 | Stream crossing | Decommissioned crossing. Channel has been skidded above road. Channel and fill slopes thru crossing are naturally rocky. Area looks stable. | L | 40 | 0 | 0 | | No Treat. |
| 309 | Stream crossing | Well decommissioned crossing. Side slopes laid back to 2:1 and well vegged. Road approaches do not deliver. | L | 100 | 180 | 3 | | No Treat. |
| 310 | Stream crossing | Decommissioned stream crossing. Channel is skidded above road. Very little channel morphology above road or below crossing. Area dense with whitethorn. | L | 30 | 30 | 38 | | No treat. |
| 311 | Stream crossing | Decommissioned stream crossing on steep stream. Slopes laid back 2:1, stream at grade. Road bed and crossing well vegged with fir trees. | L | 35 | 25 | 8 | | No treat. |
| 312 | Stream crossing | Decommissioned crossing. Road was mostly just dipped thru crossing. A 4ft stair step knick point exists from BOT to outboard road. Knick point doesn't look to be actively head cutting. Channel bottom is mossy. Fill slopes have small fir trees. | L | 70 | 10 | 12 | | No treat. |
| 313 | Stream crossing | Partially decommissioned crossing. Stream has incised to natural channel grade. Fill slopes are oversteepened but only about 4-5ft high. Area looks stable. Entire channel is covered with leaf litter, hence very little flow looks to occur here. | L | 150 | 0 | 3 | | No treat. |
| 314 | Landslide | Outboard fill failure down to major tributary. To Inman Creek. Stream presently flowing. About half of the road bed (road fill) is gone. About a 12ft road width remains. Evacuated area of slide is void of vegetation. Toe of slide is in stream. No cracks observed along remaining road bed. | M | 80 | 0 | 88 | M | 1) Excavate remaining road fill from START to END flags. 70x3x20. 2) Lay back slopes to a stable angle. 3) Spoil locally. |
| 315 | Stream crossing | Decommissioned stream crossing, Low gradient stream flows across upper end of landing. Banks have adjusted and are well vegged. Road approaches do not deliver. Stream is at grade. If this road were to be up graded, a 40ft long culvert would suffice. | L | 80 | 30 | 0 | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 316 | Stream crossing | Short spur from landing that degrades into a series of skids. Spur road is up left bank of major tributary to Inman Creek. All road fill has been pulled out of crossing. A 15cy lobe of sediment is above road, in stream channel, and may either be old skid fill or old toe of landslide/ torrent that came down stream channel at one time. Flow is bifurcating around sediment lobe. | L | 40 | 60 | 0 | | No treat. |
| 317 | Stream crossing | Fill crossing. Very little channel morphology above road. Stream flow has rilled across dipped road bed. Very little fill here. Road bed does flatten out road grade, but stream doesn't look to have enough power to incise thru fill. | L | 85 | 65 | 12 | | No treat. |
| 318 | Stream crossing | Road/Skid ends at stream. Road fill only on right bank. Up left hillslope about 70ft is a major skid that follows ridge. According to air photo, the skid goes down to Inman Creek. This road could be connected to skid for access. | L | 0 | 40 | 3 | | No Treat |
| 319 | Stream crossing | Decommissioned crossing. Channel to OBF is in fine shape, well laid back and vegged. Beyond BOT channel is down cut 1-2ft. Neither road approach delivers to the site. | ML | 70 | 0 | 97 | ML | 1) Excavate crossing from TOP to BOT with 4ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission. 3) Spoil locally. |
| 320 | Stream crossing | Culverted crossing on an otherwise decommissioned road. 6ft culvert placed on top of two Humboldt logs. Stream flow is actively scouring fill to left of inlet. Outlet of culvert is about 2ft above middle Humboldt log. This 4ft dbh log is presently half submerged in 2ft x 8ft pool. Stream is flowing and looks to have good fish habitat above crossing. Fish observed below log jam below outlet, see sketch. | ML | 260 | 50 | 210 | M | 1) Excavate crossing from TOP to BOT with10ft channel width down to natural channel grade. 2) Lay back fill slopes to 2:1 for decommission.<br>3) Spoil locally.<br>4) Install 2 XRDs to left. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 321 | Landslide | Hillslope debris slide has taken out the road and what appears to be footings of an older generation log spanner bridge that crosses a class 1 stream. Slide extends just beyond cutbank up to a network of skids. Slide area is wet and hummocky. Large logs now perpendicular to stream (old bridge) now support toe of slide. Some perched material remains along road bed and should be removed. Check site: Logs at toe of slide may be inhibiting fish passage up channel but if logs are removed slide may become more active. If logs are removed we may need to buttress slide with rock armor. Sites: 320, 321, 322 are all connected. | ML | 200 | 200 | 278 | ML | 1) Excavate 278cy of perched material. 2) Store locally. 3) Install 5 XRDs up skid #1 and 5 XRDs up skid #2, see sketch |
| 322 | Landslide | Landslide may be left approach of older generation log spanner bridge. Logs are in stream channel perpendicular to flow. Bridge may have collapsed because of landslide at site #321. Fish observed below logs. No cracks observed along roadbed above slide. Slide face is barren of vegetation. so it is assumed that slide face will continue to rill and gully in the future. | M | 0 | 0 | 26 | ML | 1) Excavate oversteepened road fill from START to END flags. 2) Spoil locally |
| 323 | Stream crossing | Decommissioned crossing. Shallow fills here. Stream grade looks shallow thru crossing relative to natural grade, though no real knick point at outboard road. Downslope stream channel is stepped. | L | 20 | 20 | 13 | | No treat. |
| 324 | Stream crossing | Decommissioned crossing. Crossing is well vegged with whitethorn. Banks are mossy and stable. Stream appears to be the left hingeline of a deep seated slow moving landslide. Slide does not appear to be active and is in a forested setting. | L | 80 | 30 | 0 | | No treat. |
| 325 | Stream crossing | Very wet springy hillside with in deep seated landslide feature. Spring flow concentrates across road bed and develops into a class II stream below road. Entire hillside and road bed are hummocky thru here. | ML | 200 | 40 | 12 | | No treat. |
| 326 | Stream crossing | Small stream formed by coalescing spring flow from large deep seated landslide. Flows from sediment path across road that is intermittent across this slide feature. | L | 20 | 60 | 0 | | No treat. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 327 | Stream crossing | Small class III stream crosses road just outside right hingeline of large deep seated landslide. Road bed intact thru here. Road has been bermed up to keep stream in natural channel. Road fill exists thru crossing. Road bed flattens natural channel grade. | ML | 30 | 150 | 10 | ML | 1) Excavate stream crossing from TOP to BOT with a 4ft channel width down to natural channel grade.<br>2) Lay back side slopes to 2:1 for decommission.<br>3) Spoil locally. |
| 328 | Landslide | Further up right road from right hingeline of large deep seated feature the road looks stable for about 100ft then a hillslope debris slide on the OBF begins. Toe of large deep seated feature may have caused Inman Creek to back up and scour left bank there by causing this hillslope debris slide. Two generations of road beds occur here on the hillside, the upper most is the more intact road. | ML | 0 | 0 | 223 | L | 1) Excavate remaining road fill from START to END flags.<br>2) Endhaul spoils. |
| 329 | Stream crossing | Not sure if stream is a class II or class I? Culvert has a 2ft drop at outlet. A log across inlet is plugging the lower 30% of the culvert with rocky sediment. An older washed out Humboldt is just up stream from inlet (see site # 330). Culvert inlet is 15ft to the left of natural stream axis due to Humboldt logs remaining on right bank above. | ML | 180 | 300 | 531 | M | 1) Excavate stream crossing from TOP to BOT with a 12ft channel width down to natural channel grade. 2) Lay back side slopes to 2:1 for decommission. 3) Spoil 500cy of fill locally and endhaul 597cy up right road to grassy meadow. 4) Install 3 XRDs up left road and 6 XRDs up right approach. |
| 330 | Stream crossing | Remaining Humboldt logs on right bank of class II stream just above inlet of 72in culvert (site#329). Left bank is mostly bedrock and appears stable. Logs on right bank look unstable and could fail into stream. Logs are presently constricting stream flow. | M | 0 | 0 | 421 | M | 1) Excavate Humboldt logs and fill from right bank above inlet of culvert.<br>2) Spoil locally. |
| 331 | Landslide | Road travels across hummocky grassland that is a part of deep seated slow moving landslide. Much of the outboard road has calved off in 2-4ft thick chunks. Area below outboard road has some recently toppled over trees. Road bed is along for the ride. Feature is much wider than above stated width. Erosion potential is based upon potential to deliver. | ML | 0 | 40 | 49 | L | 1) Excavate outboard road fill from START to END flags.<br>2) Spoil locally. 165x2x20 |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 332 | Stream crossing | Washed out fill crossing. Left road was bermed to prevent diversion. Stream has incised to natural channel grade. Stream above road travels down hummocky topography. There is a 5ft knick point at outboard road that is a rock outcrop. Fillslopes from outboard road to BOT are near vertical. Stream makes hard right turn when it reaches inboard road. | ML | 10 | 15 | 63 | L | 1) Lay back fill slopes to 2:1.<br>2) Spoil locally. |
| 333 | Stream crossing | Springy area with multiple gullies/rills coming down the cutbank to the left (downhill) is a more defined stream channel. The stream currently diverts down the inboard ditch to the confluence with the stream at Site # 334 at the inboard of the road. The spring area with multiple gullies has been dipped out to concentrate flow across the road. Both sites # 333 & 334 confluence below the road into one stream channel. | M | 10 | 70 | 71 | ML | 1. Excavate the stream channel from TOP to BOT with a 4' channel width down to the natural grade.<br>2. Lay back side slopes to 2:1 for de-commission.<br>3. Store spoils locally. |
| 334 | Stream crossing | A small 1' x 1' class 3 stream with a partially pulled crossing. It appears that the crossing was on the left hinge line. The site also receives diverted flows from Site # 333 that are greater than the flows from this stream. The combined flows are headcutting thru the fills but have been stopped by a log in the fill parallel to the road alignment. Treatment of the diversion from Site # 333 greatly reduces the erosion at this site. | ML | 40 | 90 | | ML | 1. Excavate TOP to BOT. Give the channel a 3' width. The profile has been shot 6' to the right of current alignment to align with the stream axis.<br>2. Lay back side slopes at 2:1 for decommission.<br>3. Store spoils locally. |
| 335 | Stream crossing | Decommissioned crossing. The crossing looks stable and the slopes are laid back at 2:1. The channel is not quite at grade. The channel has incised thru the fill at the outboard of the road. The stream looks to flow only during storm events. The outboard fill is well vegetated with tan oaks. | L | 15 | 80 | 17 | | NO TREAT |
| 336 | Stream crossing | No fill remains in this crossing. The channel sides are well laid back and mossy. The right approach is long but it is well drained and does not deliver to this site. If this road were to be reopened, a 40' x 24" pipe would work fine here. | L | 580 | 0 | 0 | | NO TREAT |
| 337 | Stream crossing | This a relatively large stream compared to what is shown on the topo map. There are multiple bank failures and small slumps up the channel. The stream flows transport a relatively large rocky load. The stream is in oak woodland/grassland setting. A 2' diameter oak has fallen (parallel) in the channel and is causing the aggradation of sediments in the crossing. Another spring/stream to the left confluences at the out board road. | ML | 30 | 50 | 11 | | NO TREAT |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 338 | Stream crossing | A 3' x 1' class 3 stream flows thru hummocky adjusting geology above the road. The channel braids during high flows. The stream flows to the road and then 30' to the left in a deeply incised inboard ditch and then across the road via a partially pulled crossing. This crossing drains small braids but is not the main natural channel. Flows are undercutting the road. We recommend excavating the natural channel, leaving existing crossing to drain braids. ( See sketch ) | ML | 0 | 210 | 109 | ML | 1. Excavate TOP to BOT. Use some spoil to plug the ditch. Leave the existing crossing to drain the braids.<br>2. Install 3 cross road drains up the right approach.<br>3. Store spoils locally. |
| 339 | Stream crossing | This site is a partially decommissioned crossing. The right road looks to mostly have been bermed with fill from the crossing to prevent diversion. The stream has incised down to fractured bedrock bottom. The fill slopes thru the crossing are near vertical and are actively slumping in some areas. Both approaches are well grassed over. The stream is on the left hinge line of a large deep-seated, slow earth flow. | M | 150 | 0 | 24 | ML | 1. Excavate the crossing from TOP to BOT with a 4' channel width down to channel grade.<br>2. Lay back side slopes to 2:1.<br>3. Store spoils locally.<br>4. Install 1 cross road drain up the left approach. |
| 340 | Gully | This site appears to be an old diversion gully from Site # 338. The inboard ditch has gullied down about 2' and travels down the left road, across an intersection with Left Bank Rd., and down the hillslope to Inman Creek. The majority of the road reach is thru-cut. The gully/inboard ditch looks stable. Future erosion will be dimensions above plus road length. | L | 0 | 235 | 8 | | NO TREAT |
| 341 | Landslide | The road fill at this site exhibits 6' cracks with 6" displacement. The road is 200' above an outside bend on Inman Creek. There is a 2' diameter Redwood in the center of the feature with a vertical slope on the outside edge of the tree with roots exposed. There are large fallen trees farther down the slope. The ground is 35% gradient and hummocky above the road, part of an old deep-seated landslide. A stream has cut a large gully down the left hinge line of this slide. | M | 0 | 0 | 250 | M | 1. Excavate remaining road fill. Store spoils locally. |
| 342 | Stream crossing | Tiny stream coming down forested, hummocky hillside. The stream crosses the road via a waterbar. The stream drops steeply down the outboard fill to Inman Creek. Road. The confluence of the stream and Inman Creek is located on an outside meander bend. The stream is on the left hinge line of a fillslope failure. ( Site # 341 ) The road is about 200' above Inman Creek. | M | 0 | 75 | 60 | | NO TREAT. The site will be treated with site # 341 |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 343 | Gully | Stable gully drains 360' of I.S.19 Complex Road down and across Left bank Road via a cross road drain. The gully is stable. | L | 360 | 0 | | | NO TREAT |
| 344 | Road surface | 550' of left approach and a springy hillside have developed a gully that has caused a 40' wide road fill failure. The roadbed is gone. The gully looks to be headcutting up left road. A lot of the flow contributing to the development of this gully looks to be emergent spring flow from the hillside ~100' up from the site. | M | 550 | 0 | | M | 1. Install 7 cross road drains up the left approach. |
| 345 | Road surface | Three waterbars along a 260' length of 20% road grade all deliver to a class 2 stream. Future erosion consists of rills connecting the waterbars to the stream, plus road length (i.e. persistent surface erosion). Each waterbar is about 100' apart. The roadbed is grassed over. | ML | 260 | 0 | 2 | | NO TREAT |
| 346 | Stream crossing | The origin of a large class 3 stream in a bowl shaped area has been filled to create a landing. Stream flows have been diverted down both sides of the landing using berms which have created 6'w x 6'd x 150'l gullies, the last 100' of each have active banks, down both sides of the landing. The gullies have eroded down to bedrock in places. It is very hard to calculate future erosion because it may be much greater than gully enlargement. There are saw logs buried in the fill everywhere. Estimate excavation at 6' x 6' x 150'= 200cy, but it could be much higher. | H | 250 | 0 | 100 | HM | 1. Lay back 100' of the right gully @ 2:1 and 50' of the left gully @ 2:1. ( 6' x 6' x 150' = 200cy )<br>2. Endhaul spoil using 4 trucks 100' down road to the landing |
| 347 | Stream crossing | This site is a pulled crossing. The channel has incised 1'-2' thru the fill. Both sideslopes are laid back at more than 2:1 and well vegged. Left and right sideslopes look springy. The entire right road length is dense with hydrophilic vegetation. | L | 45 | 1500 | 0 | | NO TREAT |
| 348 | Stream crossing | A small class 3 stream has washed out the crossing. The stream meanders across the road with 6" high channel walls. If this road were to be re-opened a 24" x 40' pipe would be adequate. Straighten the channel and backfill with 10 cy of fill. | L | 35 | 0 | 3 | | NO TREAT |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 349 | Stream crossing | This site is a large lobe of fill (with large woody debris) at the outboard edge of the landing. ( Below Site # 250 ) Not sure if this lobe is remains of log spanner bridge or cribbing to buttress the landing. Flow from Sites # 250 & 251 are actively scouring the upper end of the lobe. The lobe looks to be about 45' x 9' x 30' with 1/2 of the material being sediment and 1/2 large woody debris. About 40' down the channel sediment has aggraded above a large chert rock outcrop that is about 12' high. The channel below looks stable with very little wood, so future erosion is only 1/2 of actual lobe dimensions. | H | 0 | 0 | 70 | HM | 1. Excavate entire lobe of fill and large woody debris out of the channel to give the streams at Sites # 350 & 351 a direct path to the rock outcrop. 50' x 10' x 30'=450cy * Only 1/2 of the material is sediment. |
| 350 | Stream crossing | A 4x1.5 class 3 stream is conveyed across landing. Flow have cut 10' deep channel with vertical and active banks. BOT of this site is beginning of site #349. Channel morphology above is highly disturbed due heavy logging in the past. Landing was constructed here at confluence of three streams. Using very large log (3'-4' diameter) cribbing method with lots of fill on top. Site is eroding at this time. There is the potential to salvage a lot of timber at this site! | M | 85 | 0 | 1894 | HM | 1. Excavate from TOP to BOT. Clean debris from channel above IBR. Give stream a 6' wide channel through excavation. Lay back banks 2:1. Endhaul spoil 1000' to right in meadow. |
| 351 | Stream crossing | This site is a washed out stream crossing on the outer (left) end of a landing. The stream looks to be in the natural channel, but is actively incising as evidenced by a 5' headcut near the outboard edge. Crib logs are exposed below the headcut on the left bank. The left bank from the headcut to the outboard fill is actively slumping into the channel. Both fillslopes thru the crossing show signs of slumping. A trickle of water observed at the stump at BOT, which is just above the lobe of sediment at Site # 349. | HM | 0 | 50 | 243 | HM | 1. Excavate the crossing from TOP to BOT with 10' channel width and down to the natural grade.<br>2. Lay back the side slopes to 2:1.<br>3. Endhaul spoils up right road to the meadow. |
| 352 | Stream crossing | Two 4x1 class 3 streams converge near upper side of landing eroding a large gully across landing that has a lot of wood in the fill. There is log cribbing in the fill that is exposed by erosion. Channel below landing is choked with LWD. 100' of left approach (skid) delivers to site. Channel mostly vertical walls and headcuts caused by wood in the fill. | HM | 100 | 530 | 787 | HM | 1. Excavate from TOP to BOT. Give channel a 6' width through excavation. Lay back banks 2:1 for decommission. Store spoil locally on right approach.<br>2. Install long, broad cross road drain the left.<br>3. Add 5 cross road drains to right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 353 | Landslide | This site is a landing just above the confluence of two streams. The stream at Site # 352 bisects the right hinge of the landing. The left hinge of the landing butts up against a second stream to the left. The outboard fill of the landing consists of a lot of large woody debris. Large woody debris/cribbing crosses the second stream and it is aggrading sediments and has forced the flow into the hillside on the left causing a small landslide into the channel. It is difficult to determine where large woody debris/cribbing ends down the channel from the landing. Two large lobes of material (with redwoods growing out of them) exist just beyond the present edge of the landing. The second stream is flowing above the landing, but dry thru the landing. | M | 0 | 0 | 283 | M | 1. Excavate outboard edge of the landing (in between the streams) from the START to END flags, laying back fill to a stable angle.<br>2. Endhaul spoils up the right road. |
| 354 | Spring | A spring from the inboard road is conveyed across the road via a cross road drain. It has well laid back side slopes. No erosion here. The channel develops into a stream below the road. | L | 0 | 220 | | | NO TREAT |
| 355 | Stream crossing | Flow from a spur road above crosses the road here via a waterbar. The channel bottom and side slopes are mossy and naturally armored with .25' - .50' rock. The berm on the downhill side is shallow and the flow could divert down the right road. | L | 200 | 0 | 0 | L | 1. Excavate the crossing from TOP to BOT with a 4' channel width down to the natural grade.<br>2. Lay the side slopes back at 2:1.<br>3. Store spoils locally. |
| 356 | Stream crossing | This site is a pulled crossing. A little fill remain at the outboard fill. 250' of the left approach delivers to the site. | L | 250 | 0 | 9 | L | 1. Excavate from TOP to BOT. Give channel a 3' width. Lay back side slopes at 2:1. Store spoils locally.<br>2. Construct 2 cross road drains up the left approach. |
| 357 | Landslide | This site has a brow log supporting the outboard fill just above the headwaters of a class 3 stream. Small cracks (with no vertical displacement) along the outboard road. There is filter fabric over parts of the log. The right side of the log is on top of bedrock. The cutbank above is bedrock as well. | M | 120 | 0 | 67 | M | 1. Excavate all road fill from START to END flags. Remove the brow log.<br>2. Store spoils locally. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 358 | Stream crossing | A stream (that looks more gully like) comes down the hillside and crosses the road via a waterbar. Very shallow morphology. Some small deposits of sediment at the inboard road. An old past fill failure just below the waterbar indicates past diversion. Two 10' long small cracks exist at the middle of the road just above the stream indicating some past movement. The roadbed is densely vegged with Whitethorn and the fillslopes are dense with redwoods. | L | 0 | 400 | 20 | L | 1. Excavate the crossing from TOP to BOT with a 4' channel width and down to natural grade.<br>2. Lay back side slopes to 2:1.<br>3. Store spoils locally. |
| 359 | Landslide | This site is a hillslope debris slide that is within a larger deep-seated feature. There are 4' diameter stumps on the outboard fill that have been displaced and jackstraw trees with raw ground are present in the debris slide portion above and below the road. There are 5'-10' scarps in places and the entire road prism is gone in others. Future erosion is based on road fills only, but there are jackstraw trees 150' below the road on the left end of the feature. There is little effective treatment possible here. | M | 0 | 0 | 166 | | NO TREAT |
| 360 | Spring | Spring flow down hillside above or skids above. Not sure which because topography is low gradient. Spring flow enters the road at a break in slope and travels down both left and right road reaches. The flow looks to deposit most of its bed load. The flow rills down the right road for 60' then gullies down the outboard fill and continues down the hillside to Site # 356 and down the left road to Site # 355. The gully at the outboard fill and rills on the roadbed look stable and well vegetated. | L | 0 | 0 | | | NO TREAT |
| 361 | Stream crossing | This site is a small stream with a pulled crossing. Some fill remains. 150' of the right approach delivers. A gully in the outboard fill 150' to the left suggests the crossing diverted in the past. | L | 0 | 150 | 2 | L | 1. Excavate TOP to BOT. Give a 3' channel width. Lay back side slopes at 2:1. Store spoils locally.<br>2. Add 2 cross road drains up the right approach. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 362 | Gully | This gully is a continuation of the gully from Site 173. The road bed was excavated thru here to channelize flow across the road. The right fillslope and hillside above has developed into a slow moving, deep seated landslide that could catastrophically fail as a hillslope debris slide in the future. Gully flow from Site # 173 above bifurcates between these two roads. The part of the flow that goes to the right is saturating the hillside and causing this landslide. The head scarp shows up to 6' vertical displacement. A Redwood growing within the feature is tilted. | M | 0 | 25 | | M | 1. De-water the landslide above the road by diverting the flow.*<br>* See treatment for site # 173. |
| 363 | Stream crossing | This site is a small 1' x 1' class 3 stream with a pulled crossing. The side slopes are well laid back, and the channel is almost at grade. 250' of the right approach delivers. | L | 0 | 250 | 10 | L | 1. Construct 3 robust cross road drains up the right approach.<br>2. Excavate the remaining fill from the crossing. |
| 364 | Stream crossing | 40% washed out crossing. Fill slopes near vertical stream not yet to channel grade. Channel bottom well armored with natural rock that has been transported down stream. Road approaches are grassed over. Whitethorn growing with in channel and fill slopes. | M | 300 | 0 | 239 | M | 1) Excavate crossing from TOP to BOT with a 5ft channel width and laying slopes back to 2:1. 2) Spoil locally. 3) Install 2 cross road drains up left road. |
| 365 | Stream crossing | Steep 2x1 class III stream has had crossing pulled. Outboard fill on right bank has long ago failed into stream. Banks are at 2:1 and well vegged. Channel is very rocky and stepped. Little fill remains. | L | 30 | 0 | 10 | | No Treat. |
| 366 | Stream crossing | Partially pulled crossing. Fill slopes are greater than 2:1 but look stable. Stream looks to be at channel grade. Road approaches are grassed over. Channel bottom is well armored. Crossing could be left untreated. | L | 150 | 0 | 9 | L | 1) Excavate over steepened road fill along both left and right banks.<br>2) Spoil locally.<br>3) Install 1 cross road drain up left road. |
| 367 | Stream crossing | Tiny class III stream, drained by partially pulled crossing. Fill remaining in crossing. | L | 89 | 0 | 13 | L | 1) Excavate remaining fill out of crossing. 2) Spoil locally. |
| 368 | Stream crossing | Small class III looks more gully-like on hillslope above. Where stream crosses road, roadbed is totally grassed over. Outboard fill is armored with 3ft diameter rock. Stream does have diversion potential to the right where a large water bar would capture flow. Future Erosion is 20x1x1/2=0.37cy. | L | 175 | 0 | 1 | L | 1) Use Dozer to push up a berm along right hingeline to prevent diversion. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 369 | Stream crossing | Washed out Humboldt crossing. Humboldt logs remaining in fill are currently diverting stream flow to the right where flow is actively eroding right fill slope. Stream looks to be at natural channel grade, as evident by large rock outcrops. Stream is actively eroding fill and Humboldt logs and will continue. Profile was done over fill and Humboldt logs. | M | 400 | 0 | 1008 | M | 1) Excavate crossing from TOP to BOT with a 10ft channel width. 2) Spoil locally. 3) Install 3 cross road drains up left road. |
| 370 | Landslide | Drainage down skid road above this site adds additional flows to springy hillside that has failed taking entire 40ft section of road downslope. Some fill is perched 20ft above stream at site#369. The only treatment here is disconnection skid flow. | ML | 250 | 0 | 16 | L | Install 5 cross road drains up skid. |
| 371 | Landslide | Hillslope debris slide down to Inman Creek. Top of slide is at roadbed. Almost entire road is gone through slide feature. Some cracks and small slumps near top indicate future erosion. Three large redwoods at toe of slide are leaning over across Inman Creek. Slide area is grassy with sparse whitethorn. Two springs/stream within slide face. Future erosion is road fill only. | M | 300 | 0 | 42 | | No treat |
| 372 | Stream crossing | Small stream has been diverted down Inboard ditch to protect landslide to no avail. Only 4ft of road prism remains here. There is fill to be excavated here but road opening costs don't seem to justify it. | HM | 20 | 0 | 52 | ML | 1) Excavate crossing from TOP to BOT down to natural channel grade and laying slopes back to 2:1. 2) Spoil locally. |
| 373 | Stream crossing | Pulled crossing. Slopes are laid back to greater than 2:1. Area looks stable. Crossing in hardwood mixed conifer forest. | L | 0 | 70 | 0 | | No Treat. |
| 374 | Stream crossing | Small class III stream has been decommissioned. Flows have cut 2ft deep gully thru remaining fill. | ML | 65 | 89 | 28 | L | 1) Excavate crossing form TOP to BOT with a 4ft channel width down to channel grade and lay slopes back to 2:1. 2) Spoil locally |
| 375 | Stream crossing | Pulled crossing. Stream has incised about 1ft through crossing but slopes have remained stable. Whitethorn growing in channel. Crossing is in hardwood forest. | ML | 70 | 10 | | | No Treat. |
| 376 | Stream crossing | Stream or maybe concentrated skid flow crosses road via dipped out crossing. Area very stable. Hard to say if this flow reaches Inman Creek. | L | 0 | 40 | 0 | | Not Treat. |
| 377 | Landslide | Deep seated slide in spring area. Juncus on and below road prism. Slide above road onto road. Steep torrent below road into class III stream. | M | 0 | 0 | 44 | L | 1) Excavate remaining 59cy of road fill. Store on landing to left. |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 378 | Stream crossing | Two class II streams confluence on roadbed. Crossing has been pulled. Large bolder at bot is causing stream flow to bifurcate. Streams looks to be at channel grade. | L | 40 | 20 | 0 | | No Treat. |
| 379 | Stream crossing | This is a partially pulled crossing. Area was excavated to define channel across road to prevent diversion. Stream has a knick point of fill at OBR where flow changes grade from 10% to 80%. Area looks stable. Mature redwoods are growing in fill here. Stream channel above road is filled with leaves and looks only to flow during storm events. | ML | 40 | 10 | 78 | ML | 1. Excavate crossing from TOP to BOT with 4' channel width. Lay banks back to 2:1 for decommission. Spoil locally. |
| 380 | Stream crossing | A 2x1 class 3 stream has been partially decommissioned. Flows have downcut to channel grade but side slopes are near vertical but mossy and extremely well vegetated with whitethorn. Lots of juncus on road bed on both sides of crossing. Little contribution from either approach. | ML | 120 | 0 | 83 | M | 1. Excavate from TOP to BOT. Give stream a 4' channel width. Lay back banks 2:1. Spoil local. |
| 381 | Stream crossing | Partially pulled crossing has incised to natural grade. Fill slopes are near vertical. Some shallow failures are occurring (as evident by recently toppled madrone). In general, site looks to be stabilizing. Stream has old gully above road that parallels channel on left bank. Stream has since incised below gully and is presently in natural channel. | ML | 50 | 20 | 56 | L | 1. Excavate crossing from TOP to BOT with a 4' channel width. Lay back banks to 2:1. Spoil locally. |
| 382 | Stream crossing | Washed out stream crossing. Stream looks to be at channel grade. Fill slopes are near vertical. Area looks stable. No signs that crossing was pulled. | ML | 70 | 0 | 89 | L | 1. Layback both left and right fillslopes to 2:1 for decommission. Spoil locally. |
| 383 | Stream crossing | Class 3 2x1 stream. Xing has been partially decommissioned. Flows have cut thru fill down to channel grade. Flows from left approach have eroded small gully down to channel at OBR. | ML | 110 | 0 | 26 | L | 1. Excavate from TOP to BOT. Give stream a 4' channel width. Lay back banks to 2:1. Spoil local.<br>2. Install 2 XRDs to left approach. |
| 384 | Stream crossing | Pulled crossing. Looks as though fill was left in bottom of crossing and side slopes were not laid back to 2:1. Stream (presently flowing) has since cut 2'-3' down thru fill. Left fill slope /bank is near 45 degree angle but look stable. Right bank is actively slumping and gullying into channel. A cross road drain 40' up right road cuts off roads runoff to this site. | M | 20 | 40 | 38 | L | 1. Lay back both left and right fillslope to 2:1. Spoil locally. |
| 385 | Landslide | This appears to be the toe of a very large slide above. The ground is very hummocky. The trees are not jackstraw, but separated into clumps. No treatment is apparent. | L | 0 | 0 | | | No treat |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 386 | Stream crossing | Pulled crossing. Stream at grade/bedrock. Stream grade stair-steps down hillside. OBF on right road approach has failed into stream just outside hingeline. Area looks relatively stable. FE is OBF on right hingeline. | L | 40 | 200 | 8 | | No treat |
| 387 | Stream crossing | Pulled crossing. Small stream coming down hillside. Road bed has been partially excavated to channelize flow across road. Some fill remaining in xing but area looks stable. | L | 0 | 0 | | | No treat |
| 388 | Stream crossing | A 4x1 class 3 stream has eroded new channel vertically thru toe of landslide. Stream appears to be near channel grade with side slopes near 2:1 and well vegetated. Reluctant to call for any excavation on slide toe just above possible class 1 stream | M | 20 | 25 | | | No treat |
| 389 | Stream crossing | Pulled xing on flowing class 2. Area looks stable. Right bank is oversteepened (~1:1) and is mostly grassy though appears to be experiencing shallow failures/sloughing. Large fir and whitethorn growing on road above. | ML | 60 | 20 | 17 | | No teat |
| 390 | Stream crossing | Pulled crossing just above site #389. Crossing down to bedrock channel. Slopes are steep (>2:1) but look stable. | L | 50 | 0 | | | No treat |
| 391 | Landslide | 700' of steep left approach drains to this road fill failure. Toe of slide is in class 2 stream. No fill remains (road prism is gone) but left approach has a large berm at OBF and retains flows that gully down this road. Several small cutbank slides and brush on left approach. Slide is re-vegetated with ferns, whitethorn, and small Doug firs. | ML | 700 | 0 | | L | Install 14 XRDs up left approach |
| 392 | Road surface | Concentrated flow down two skids crosses road and gullies road bed. Just below road is the beginning of a class 3 stream. Right road has a berm to prevent diversion. Gully, road bed, and skids are all mossy with small huckleberry. | ML | 70 | 0 | 2 | | No treat |
| 393 | Stream crossing | This small class 2, 2' x 1' stream has been decommissioned. A small sediment wedge remains behind the outboard fill that is armored with 3' x 4' x 2' concrete blocks and large boulders. The channel is well vegged with ferns. (If this road were re-opened, the berm on either side of the crossing could be bladed out in both directions and this crossing would serve as an armored fill crossing. Cross sections and profile have been surveyed just in case. The road is frequently drained with large cross road drains. | L | 8 | 70 | 7 | | NO TREAT |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 394 | Stream crossing | This site is a spillway for a small pond located just above the road. Pond size is roughly 60' x 40'. The road fill has been pulled at the spillway. The spillway is very low gradient and well vegetated. The swale below the road continues to be very low gradient. There is no future erosion here. Pulled fill material is stacked up on either side of the spillway. This spot is VERY good for aquatic habitat. If upgrade: install a 24" x 20' pipe here and cover it with the fill piles on either side of the spillway. | L | 120 | 100 | | | NO TREAT |
| 395 | Stream crossing | A 4' x 1' class 2 stream flows thru a poorly pulled crossing. The flow now meanders across the road but is almost at grade thru the crossing. A large rain event could wash out the rest of the crossing though.* If upgrade: install a 30" culvert. | M | 230 | 130 | 67 | M | 1. Excavate the crossing from TOP to BOT. Give the stream a 4' channel width. Store spoils locally. 2. Install 2 cross road drains to the left and one to the right. |
| 396 | Stream crossing | A small 2' x 1' class 3 stream has decommissioned itself. The stream is located in a very unstable, very large bowl/deep seated landslide. This area will chronically leak sediment from above, but no treatment feasible. The approaches do not deliver as they are hummocky and covered with cut bank slides. | L | 60 | 40 | 2 | | NO TREAT |
| 397 | Stream crossing | This is a tiny stream with a pulled crossing. No fill remains. The short approaches do not deliver. If the road were ever reopened, a 24" x 40' culvert would work here. | L | 40 | 80 | | | NO TREAT |
| 398 | Stream crossing | A 2' x 1' class 3 stream crosses the road prism here. The fill from the crossing has been well pulled. The banks are laid back to 2:1 and the stream channel is stable. The road approaches do not deliver. The road bed is hummocky and densely overgrown in each direction. Pulled fill is stacked to the left of the crossing. | L | 25 | 85 | | | NO TREAT |
| 399 | Stream crossing | This site is a pulled crossing of a 3' x 1' class 3 stream. No fill remains in the crossing. The jumbled approaches do not deliver. | L | 85 | 75 | | | NO TREAT |
| 400 | Stream crossing | A 3' x 1' class 2 stream flows across the road prism here. The vast majority of the fill has been pulled and placed at either side of the excavation. The stream itself has cut thru any fill they left behind. The banks are laid back and stable. The entire area is covered with a lot of ferns. The outer edge of the left bank is perched and may deliver ~5 cy of material. | L | 20 | 28 | 5 | | NO TREAT |

**General information for road-related erosion sites, Inman Creek and Indian Springs watersheds, The Garcia Forest, Mendocino County, CA**

| Site # | Problem | Comment on Problem | Erosion Potential | Left ditch/ road length (ft) | Right ditch road length (ft) | Future Yield (yds3) | Treatment Immediacy | Comment on treatment |
|---|---|---|---|---|---|---|---|---|
| 401 | Spring | Significant spring flow from long springy area flows across a landing causing headcutting at the outboard fill at this site. The future erosion is based on the headcut migrating across the landing. This site is way too brushy with whitethorn to profile. | M | 80 | 0 | 67 | M | 1. Excavate channel across the landing. Give excavation a 4' bottom width. Lay back the sides at 2:1 for 50'. (8’ deep at the outboard fill and 2' at the inboard side.<br>2. Store the spoil locally. |
| 402 | Stream crossing | This site is a 5' x 1' class 3 stream with a pulled crossing. 4'l x 3'w x 2'd concrete blocks are used to armor the outboard fill. The crossing was decommissioned and 1 lower block was removed to allow flow to pass. Four others remain in place. 15 cy of sediment remains behind the blocks on the right bank. (See sketch). Both approaches deliver very slightly. | ML | 230 | 220 | 15 | L | 1. Remove the blocks and store locally.<br>2. Lay back the right bank to 2:1 (15 cy). Store locally<br>3. Add 1 cross road drain to the right approach and 1 to the left. |
| 403 | Stream crossing | This is a very small 2' x 1' class 3 stream flowing onto the roadbed. This is not a place where a stream should be. The hillslope above is so disturbed that the hydrology here makes little sense. At any rate, this spot is channeling flow at the moment. The flow hits the road and diverts 40' to the right where it exits the road bed. The erosion disappears into hummocky area below. The road below is a springy and well vegetated. NO TREAT NO DELIVERY | M | 125 | 0 | | | NO TREAT |

# Appendix B.

## Typical Construction Drawings

### for Recommended Treatments on the Surveyed Roads within the Inman Creek watershed, Garcia River Forest Phase 1 Road Erosion Assessment, Mendocino County, California.

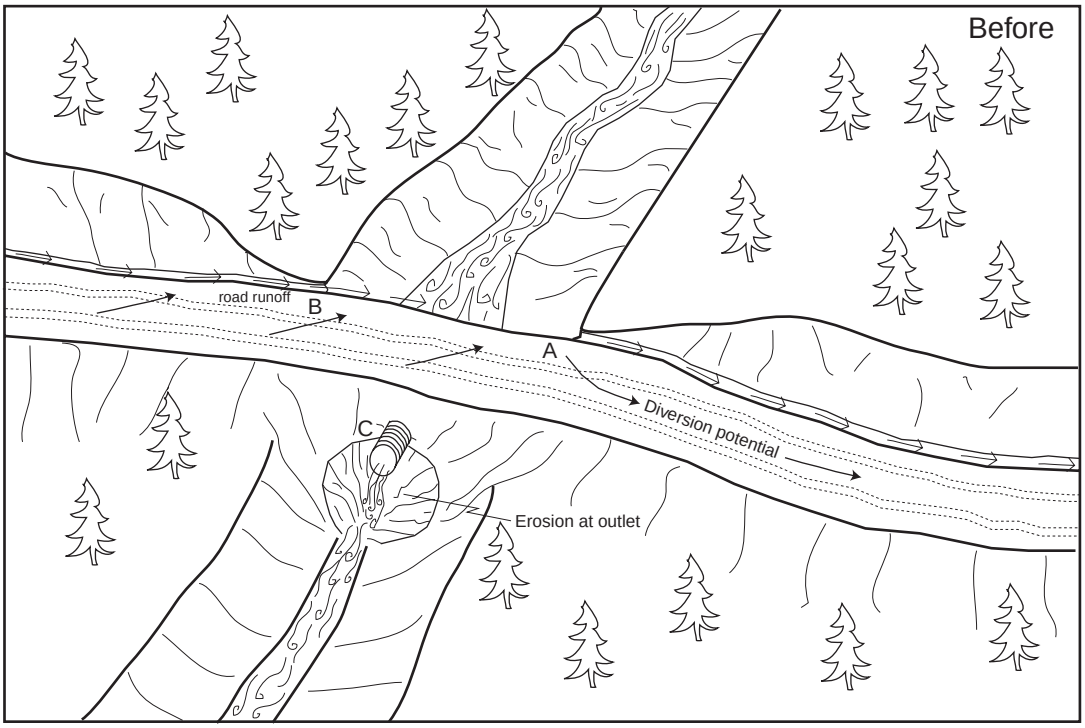
# Typical Schematic
# Components of an upgraded stream crossing

## Common problems

A - Diversion potential

B - Road surface and ditch drains to stream

C - Undersized culvert high in fill with outlet erosion

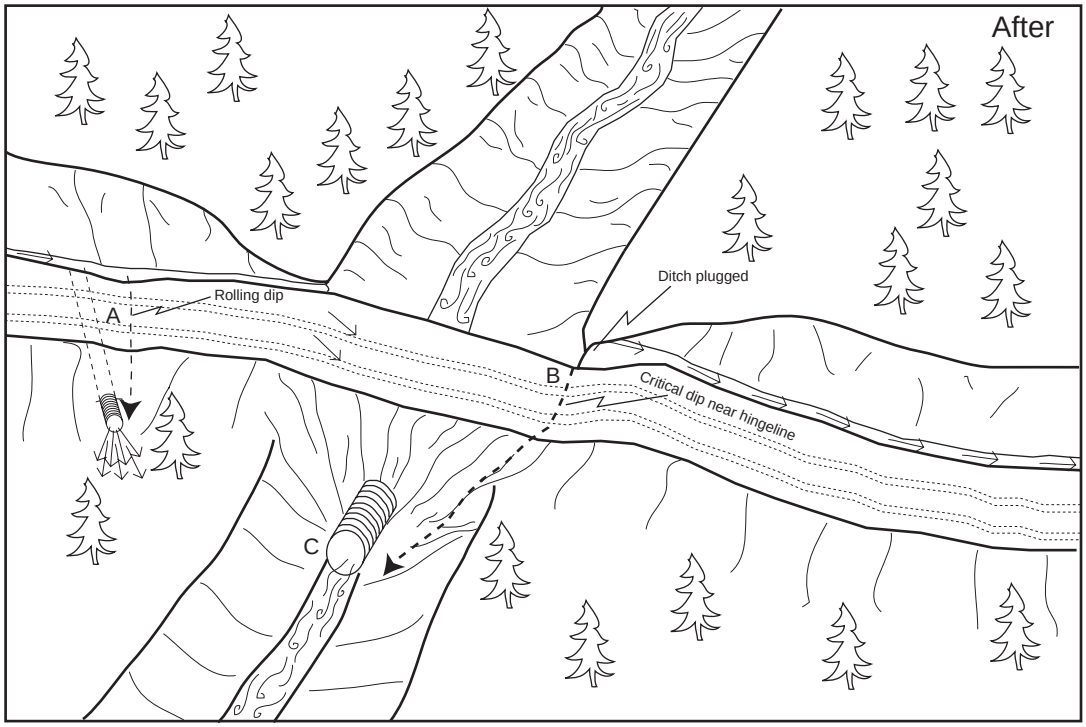



## General Standards

A - Road surface and ditch "disconnected" from stream

B- No diversion potential

C- 100 year culvert set at base of fill

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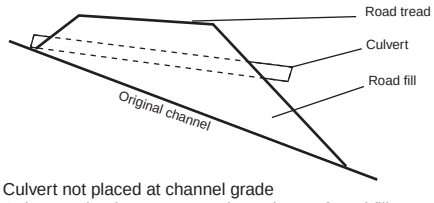
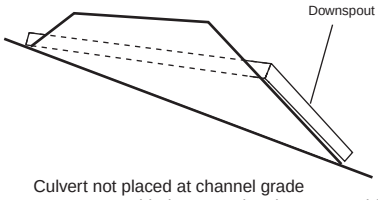
# Typical design of non-fish bearing culverted stream crossings

Existing



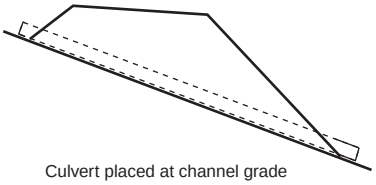

Culvert not placed at channel grade
Culvert outlet does not extend past base of road fill

Upgraded



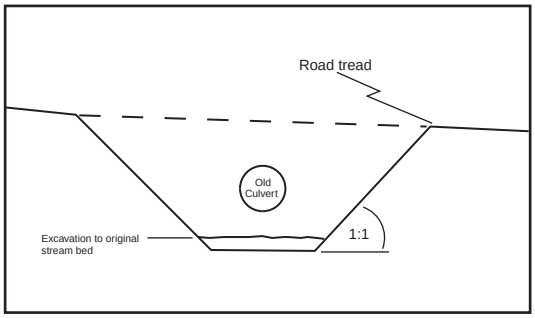

Culvert not placed at channel grade
Downspout added to extend outlet past road fill

Upgraded (preferred design option )

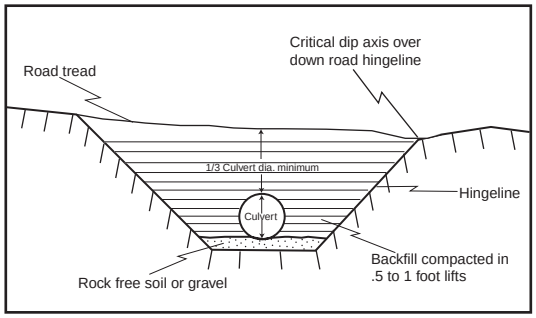


Culvert placed at channel grade
Culvert inlet and outlet resting on or partially in the original stream bed

Excavation in preparation for upgrading culverted stream crossing




Upgraded stream crossing culvert installation




## Typical installation of non-fish bearing culverted stream crossings

Road upgrading tasks typically include upgrading stream crossings by installing larger culverts and inlet protection (trash barriers) to prevent plugging. Culvert sizing for the 100 year flood flow should be determined by both field observation and calculations using a procedure such as the Rational Formula.

### Stream crossing culvert installation

1) Culverts shall be aligned with natural stream channels to ensure proper function, prevent bank erosion and debris plugging problems.
2) Culverts shall be placed at the base of the fill and at the grade of the original streambed or downspouted past the base of the fill.
3) Culverts shall be set slightly below the original stream grade so that the water drops several inches as it enters the pipe.
4) Culvert beds shall be composed of rock free soil or gravel, evenly distributed under the length of the pipe.
5) To allow for sagging after burial, a camber shall be between 1.5 to 3 inches per 10 feet culvert pipe length.
6) Backfill material shall be free of rocks, limbs or other debris that could dent or puncture the pipe or allow water to seep around pipe.
7) One end of the culvert pipe shall be covered then the other end. Once the ends have been secured, the center will be covered.
8) Backfill material shall be tamped and compacted throughout the entire process.
-Base and side wall material will be compacted before the pipe is placed in its bed.
-Backfill compacting will be done in 0.5- 1 ft lifts until 1/3 of the diameter of the culvert has been covered. A gas powered tamper can be used for this work.
9) Inlets and outlets shall be armored with rock or mulched and seeded with grass as needed.
10) Trash protectors shall be installed just upstream from the culvert where there is a hazard of floating debris plugging the culvert.
11) Layers of fill will be pushed over the crossing until the final, design road grade is achieved, at a minimum of 1/3 to 1/2 the culvert diameter.

### Erosion control measures for culvert replacement

Both mechanical and vegetative measures will be employed to minimize accelerated erosion from stream crossing and ditch relief culvert upgrading. Erosion control measures that are implemented will be evaluated on a site by site basis. Erosion control measures that may be employed include but are not limited to:
1) Minimizing soil exposure by limiting excavation areas and heavy equipment disturbance.
2) Installing filter windrows of slash at the base of the road fill to minimize the movement of eroded soil to downslope areas and stream channels.
3) Retaining rooted trees and shrubs at the base of the fill as "anchor" for the fill and filter windrows.
4) Bare slopes created by construction operations will be protected until vegetation can stabilize the surface. Surface erosion on exposed cuts and fills will be minimized by mulching, seeding, planting, compacting, armoring and/or benching prior to the first fall rains.
5) Extra or unusable soil will be stored in long term spoils disposal locations that are not limited by factors such as excessive moisture, steep slopes greater than 10%, archeology potential or proximity to a watercoarse.
6) On running streams water will be pumped or diverted past the crossing and into the down stream channel during the construction process.
7) Straw bales and/or silt fencing will be employed where neccessary to control runoff within the construction zone.

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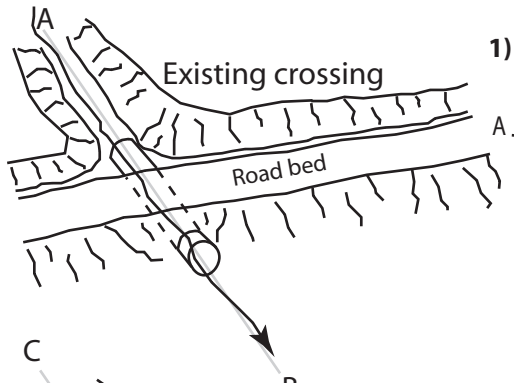
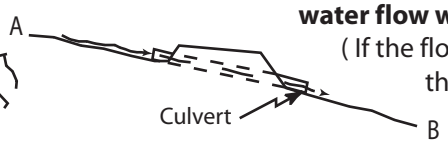
# 10 steps to building an armored fill stream crossing

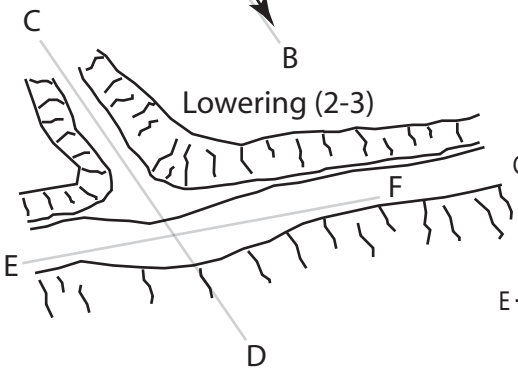


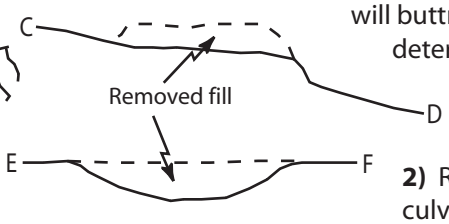




**Building an armored fill**

**1)** The two most important concepts to understand when constructing an armored fill are:

A) **The rock must be placed in a "U" shape across the channel so that the water flow will always stay confined within the armored area.** ( If the flow gets around the rock armoring it will quickly gully through the remaining road fill. Proper shaping of the remaining road fill and good armor placement will reduce the likelihood of crossing failure. )

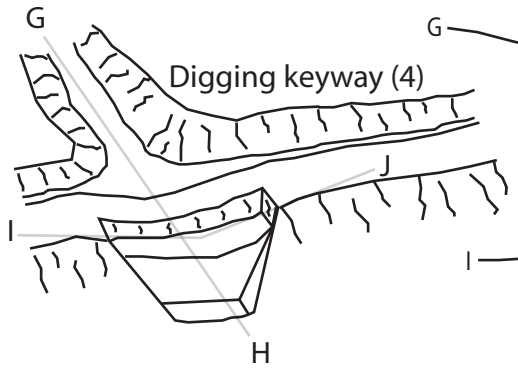


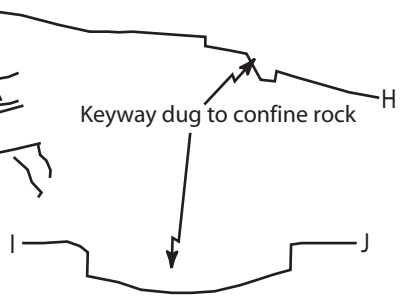




B) **The largest rocks must be used to butresss the rest of the rock armor in two locations:** 1b) The base of the armored fill where the road fill meets the natural channel. ( This will buttress the armor placed on the outboard road fill face and reduce the likelihood of it washing downslope.)

2b) The break in slope from the road tread to the outer fill face. ( This will buttress the fill placed on the outer road tread and will determine the "base level" of the creek as it crosses the road surface.)

**2)** Remove any existing drainage facilities including culverts and humboldt logs.

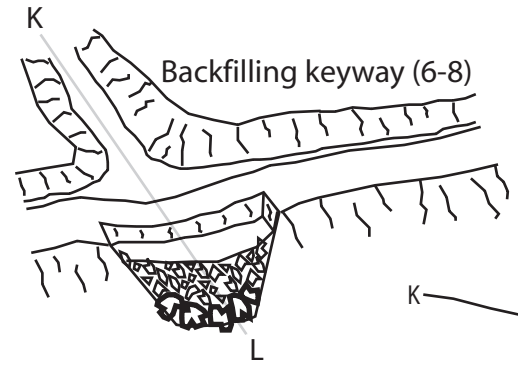


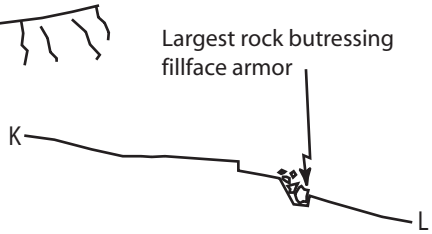




**3)** Costruct a dip centered at the crossing that is large enough to accomodate the 100 yr. flow event and prevents diversion. (C-D, E-F)

**4)** Dig a keyway (to place the rock in) that extends from the outer 1/3 of the road tread down the outboard road fill to where the outboard fill meets the natural channel, up to 3' into channel bed depending on site specific specifications. (G-H, I-J)

**5)** (Optional) Install geofabric within keyway to support rock in wet areas and to prevent winnowing of the crossing at low flows.

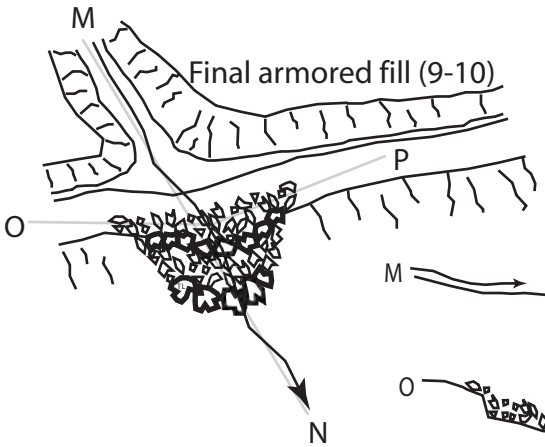


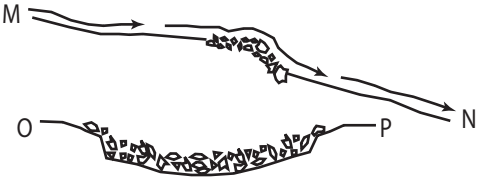




**6)** Put aside the largest rock armoring to create 2 buttresses in the next step. (K-L)

**7)** Use the largest rock available (as described in the treatment specifications at the site) to create a buttress at the base of the fill, (this should have a "U" shape to it and it will define the outlet of the aromored fill.)

**8)** Backfill the fillface with remaining rock armor making sure the final armored area has a "U" shape that will accomodate the largest expected flow. (K-L)



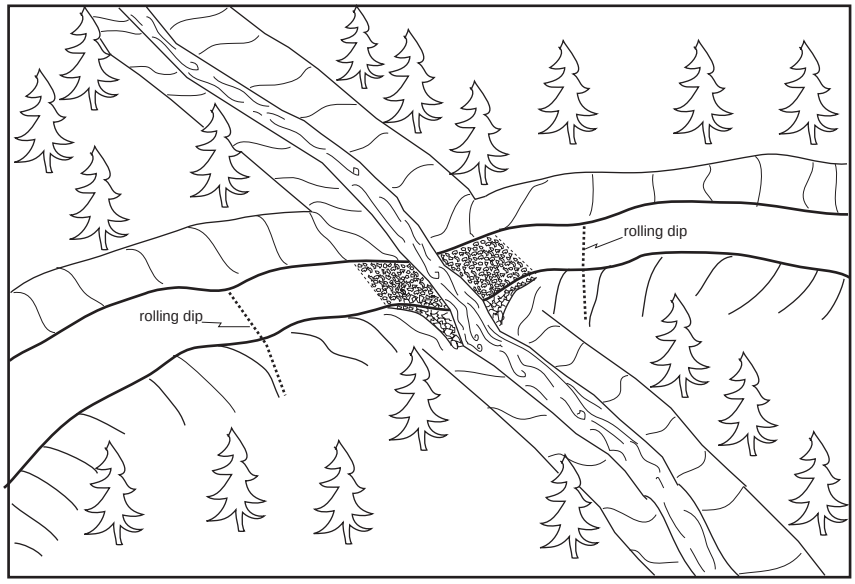




**9)** Install a second buttress at the break in slope between the outboard road and the outboard fill face, (this should define the base level of the stream and determine how deep the stream will backfill after construction.) (M-N)

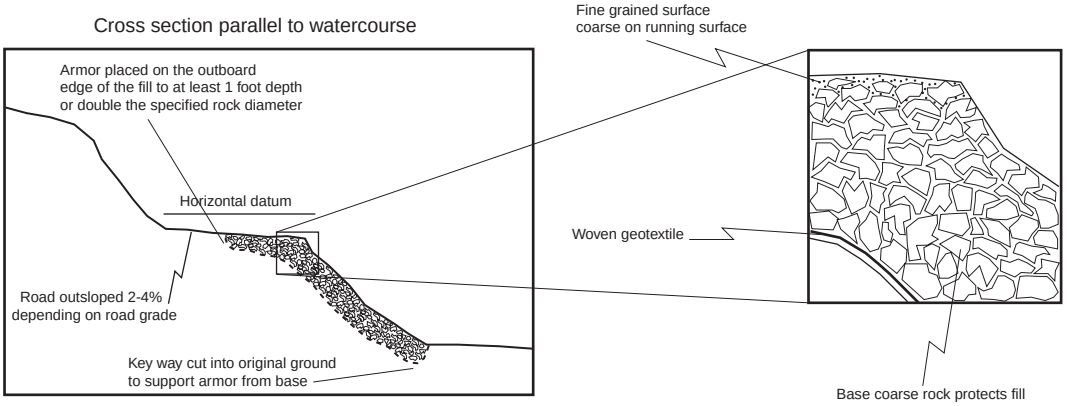
**10)** Back fill the rest of the keyway with the unsorted rock armor making sure the final armored area has a "U" shape that will accomodate the largest expected flow (O-P)

Pacific Watershed Associates (2005)

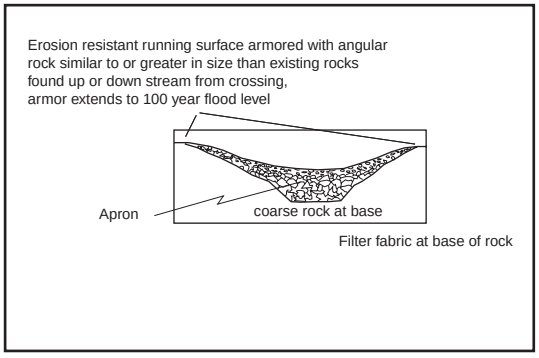
# Typical armored fill crossing installation




Cross section parallel to watercourse




Cross section perpendicular to watercourse

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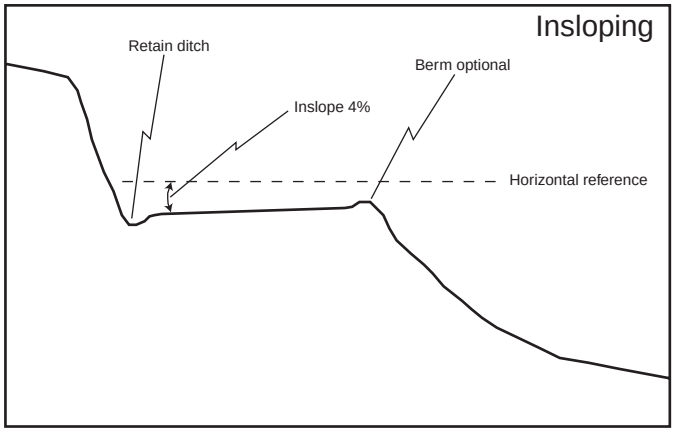
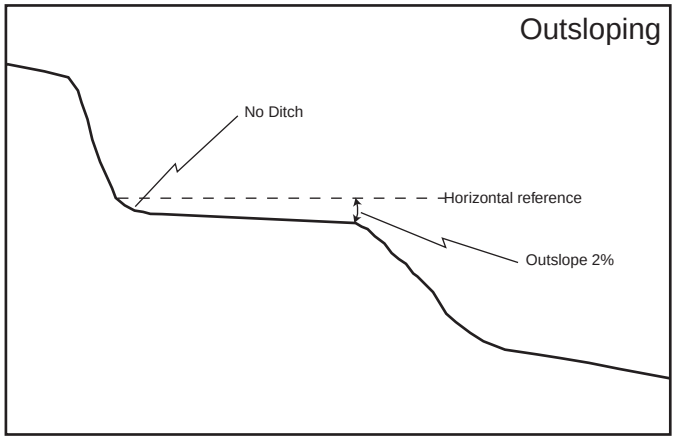
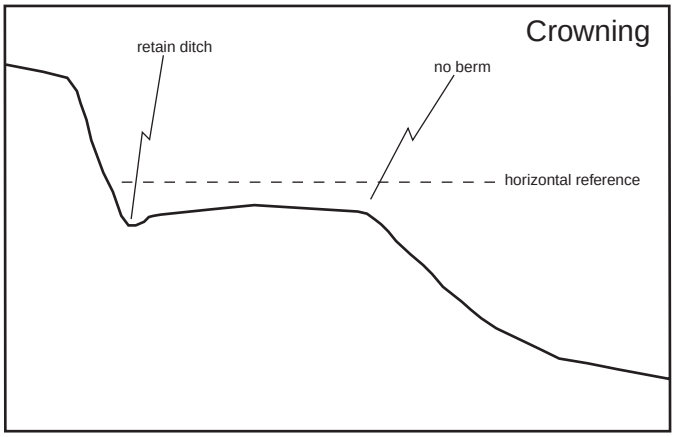
# Using road shape to control road runoff




| Outsloping pitch for roads up to 8% grade | | |
|---|---|---|
| Road grade | Outslope pitch for unsurfaced roads | Outslope pitch for surfaced roads |
| 4%, or less | 3/8" per foot | 1/2" per foot |
| 5% | 1/2" per foot | 5/8" per foot |
| 6% | 5/8" per foot | 3/4" per foot |
| 7% | 3/4" per foot | 7/8" per foot |
| 8%, or more | 1" per foot | 1 1/4" per foot |

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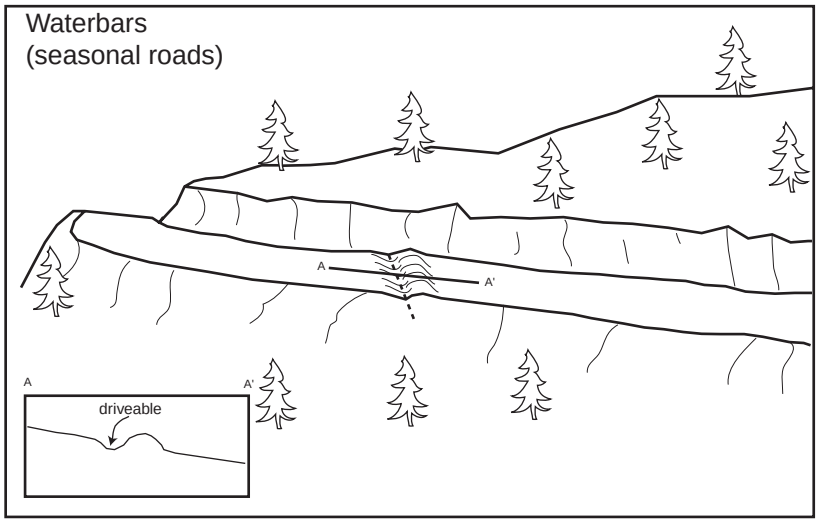
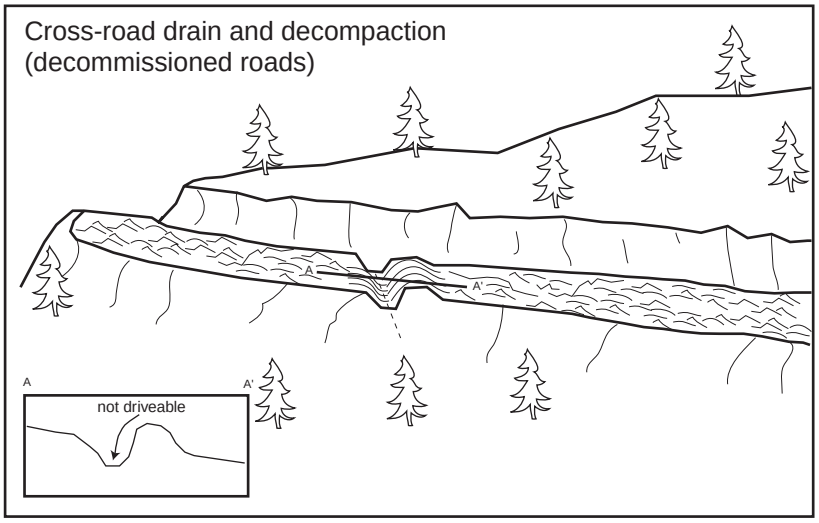
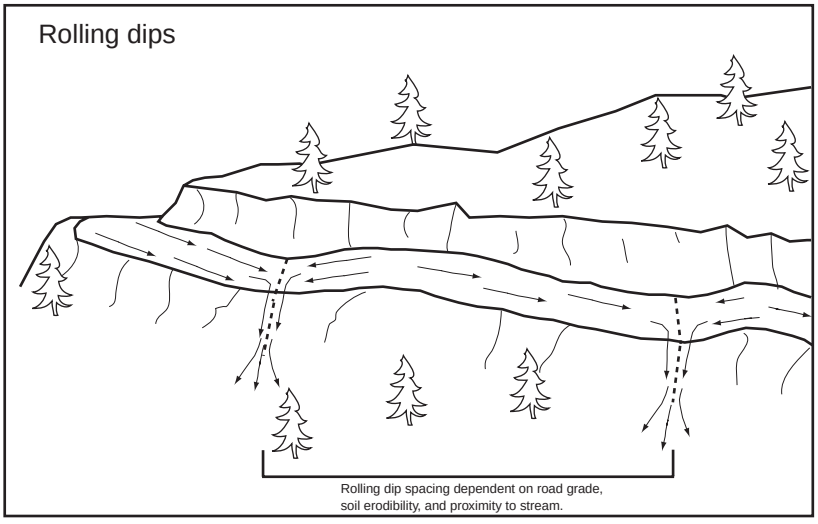
# Dispersing road surface runoff

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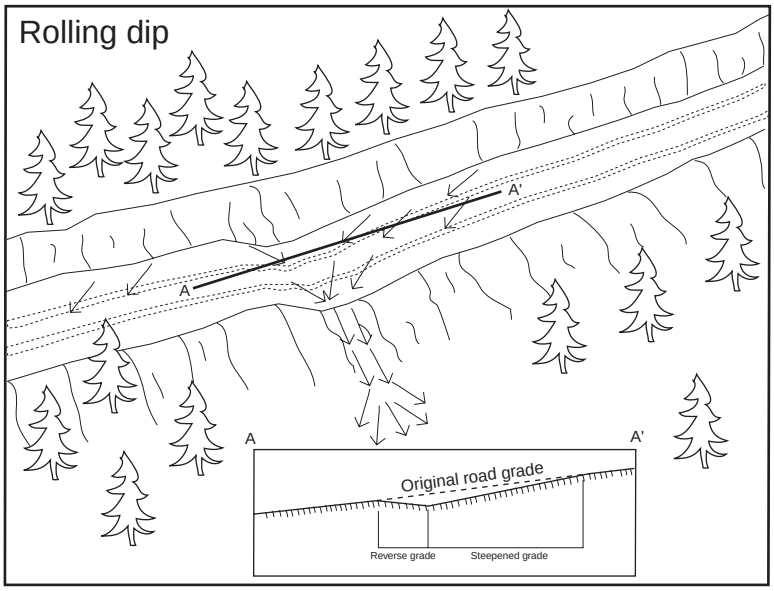
# Road surface drainage by rolling dips




**Rolling dip installation:**

1) Rolling dips will be installed in the road bed as needed to drain the road surface.
2) Rolling dips will be sloped either into the ditch or to the outside of the road edge as required to properly drain the road.
3) Rolling dips are usually built at 30-45 degree angles to the road alignment with cross grade of at least 1 percent greater than the grade of the road.
4) Excavation for the dips will be done with a medium size bulldozer or similar equipment.
5) Excavation of the dips will begin 50 to 100 feet up-road from where the axis of the dip is planned per guidelines established in the rolling dip dimensions table.
6) Material will be progressively excavated from the road bed, steepening the grade until the axis is reached.
7) The depth of the dip will be determined by the grade of the road (see table).
8) On the down-road side of the rolling dip axis a grade change will be installed to prevent the runoff from continuing down the road (see figure).
9) The rise in grade will be carried for about 10 to 20 feet then it will fall to the original slope.
10) The transition from axis to bottom, through rising grade to falling grade will be in a road-distance of at least 15 to 30 feet.

Table of rolling dip dimensions

| Road grade | Upslope approach (distance from up-road start of rolling dip to trough) (ft) | Reverse grade (Distance from trough to crest) | Depth below average road grade at discharge end of trough. (ft) | Depth below average road grade at upslope end of trough. (ft) |
|---|---|---|---|---|
| <6 | 55 | 15-20 | 0.9 | 0.3 |
| 8 | 65 | 15-20 | 1.0 | 0.2 |
| 10 | 75 | 15-20 | 1.1 | .01 |
| 12 | 85 | 20-25 | 1.2 | .01 |
| >12 | 100 | 20-25 | 1.3 | .01 |

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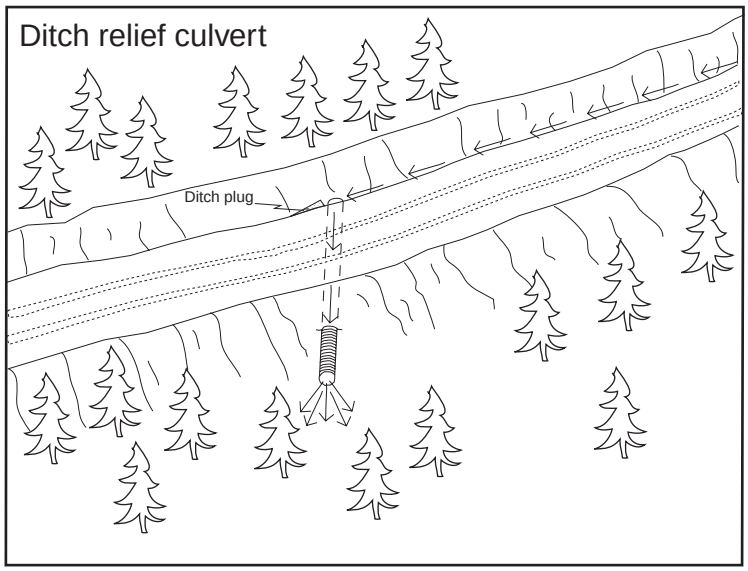
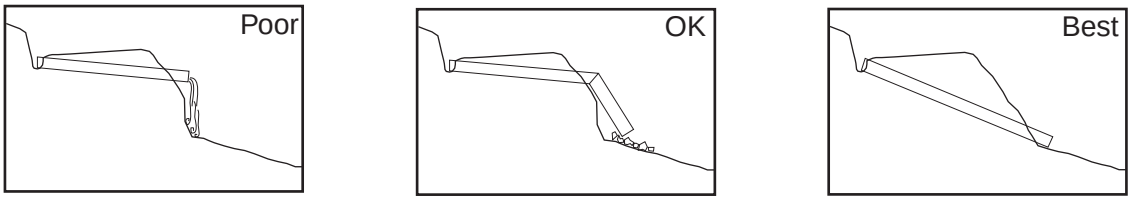
# Typical ditch relief culvert installation




Cross sections of typical installations




Ditch relief culvert installation

1) The same basic steps followed for stream crossing installation shall be employed.
2) Culverts shall be installed at a 30 degree angle to the ditch to lessen the chance of inlet erosion and plugging.
3) Culverts shall be seated on the natural slope or at a minimum depth of 5 feet at the outside edge of the road, whichever is less.
4) At a minimum culverts shall be installed at a slope of 2 to 4 percent steeper than the approaching ditch grade, or at least 5 inches every 10 feet.
5) Backfill shall be compacted from the bed to a depth of 1 foot or 1/3 of the culvert diameter, whichever is greater, over the top of the culvert.
6) Culvert outlets shall extend beyond the base of the road fill (or a flume downspout will be used).Culverts will be seated on the natural slope or at a depth of 5 feet at the outside edge of the road, whichever is less.

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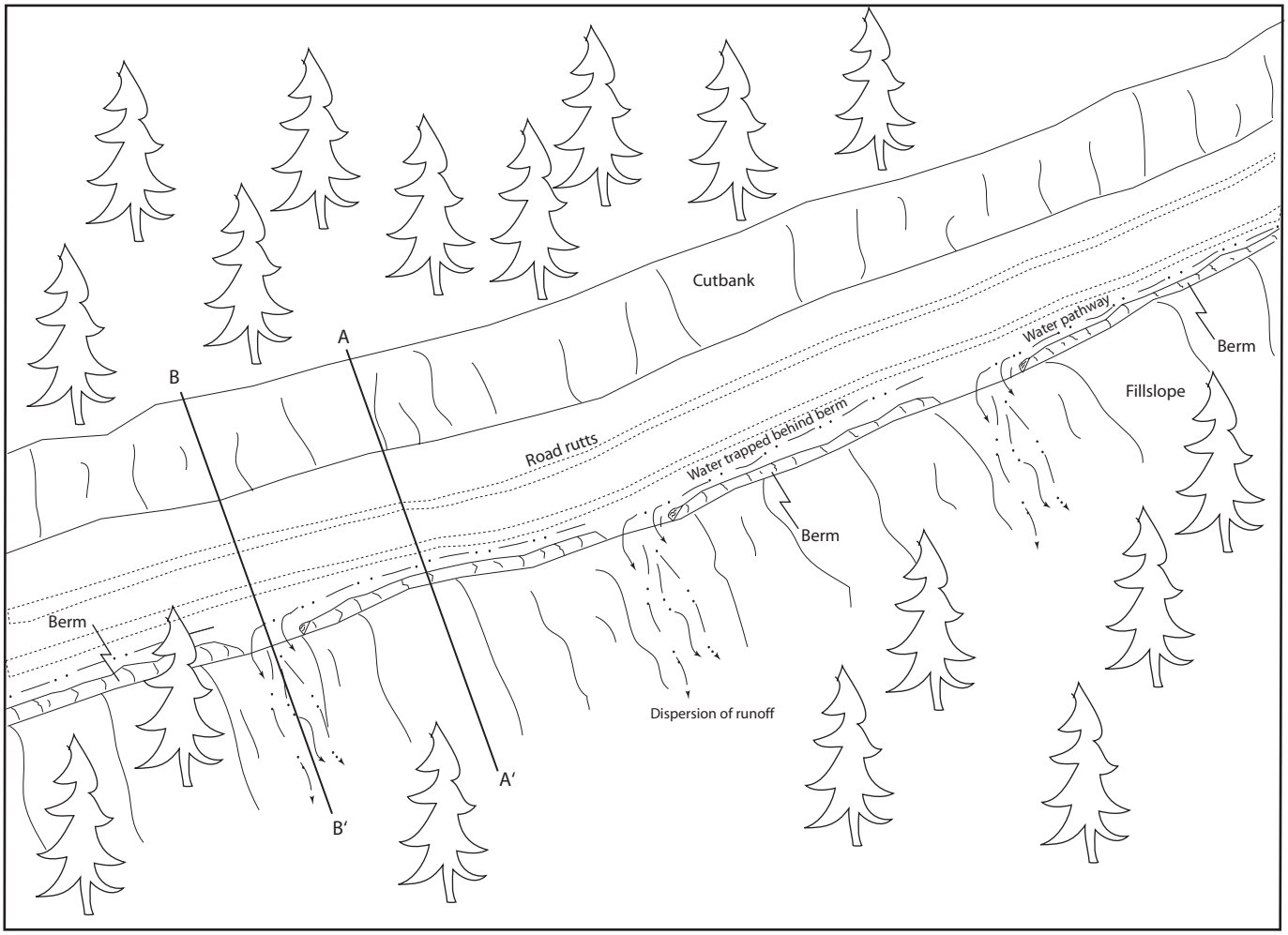
# Removing outboard berms on maintained roads

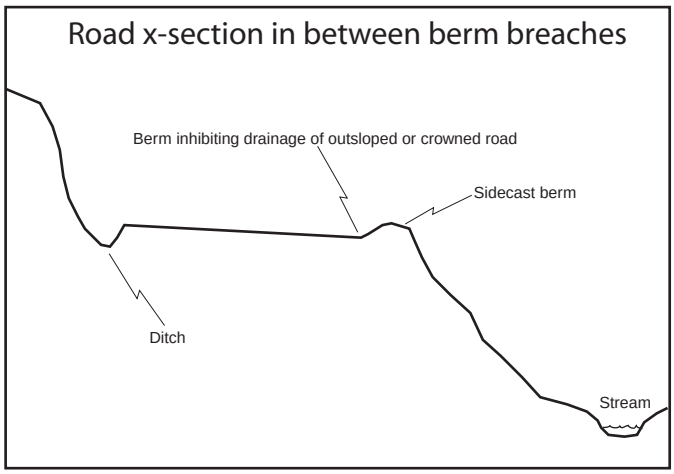
## Either by sidecast or excavation methods

1) On gentle road segments berms can be removed continuously (see B-B')
2) On steep road segments, where safety is a concern, the berm can be frequently breached (see A-A' & B-B')
Berm Breaches should be spaced every 30 to 100 feet to provide adequate drainage of the road system while maintaining a semi-continuous berm for safety reasons



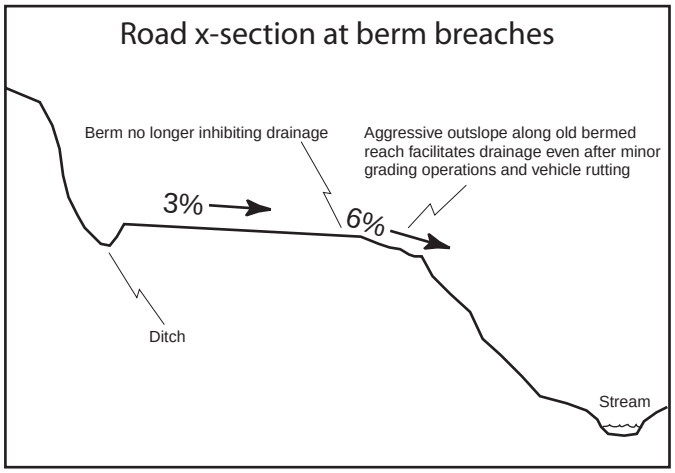

A A'

### Road x-section in between berm breaches




B B'

### Road x-section at berm breaches

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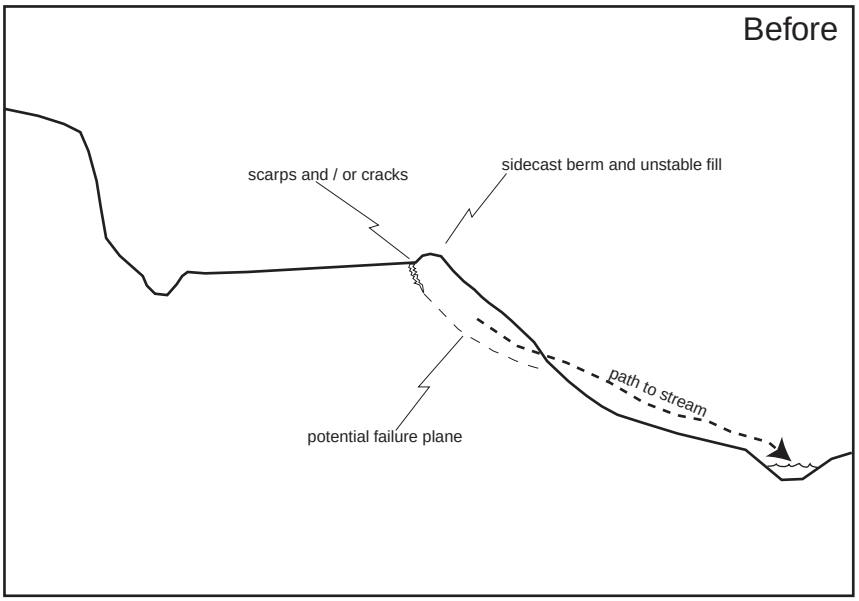
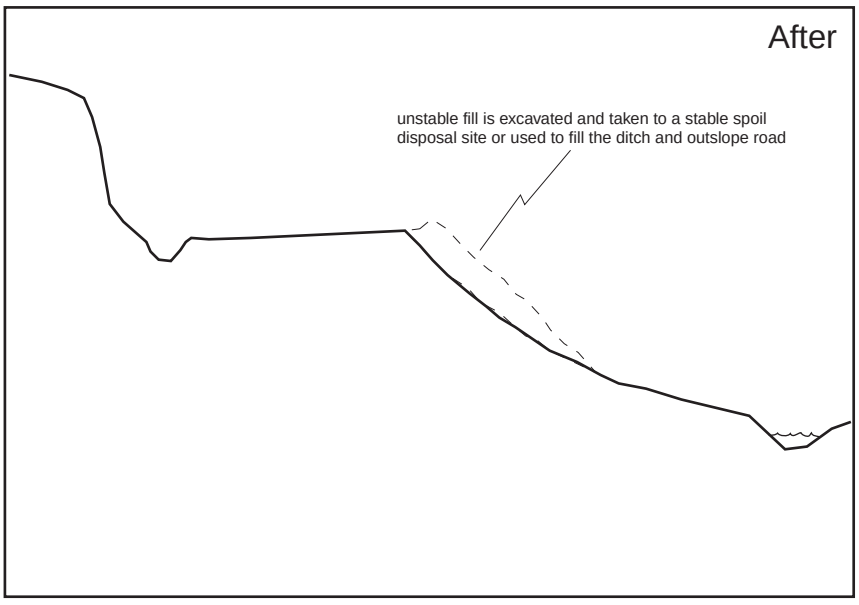
# Excavating unstable fill slope on maintained road

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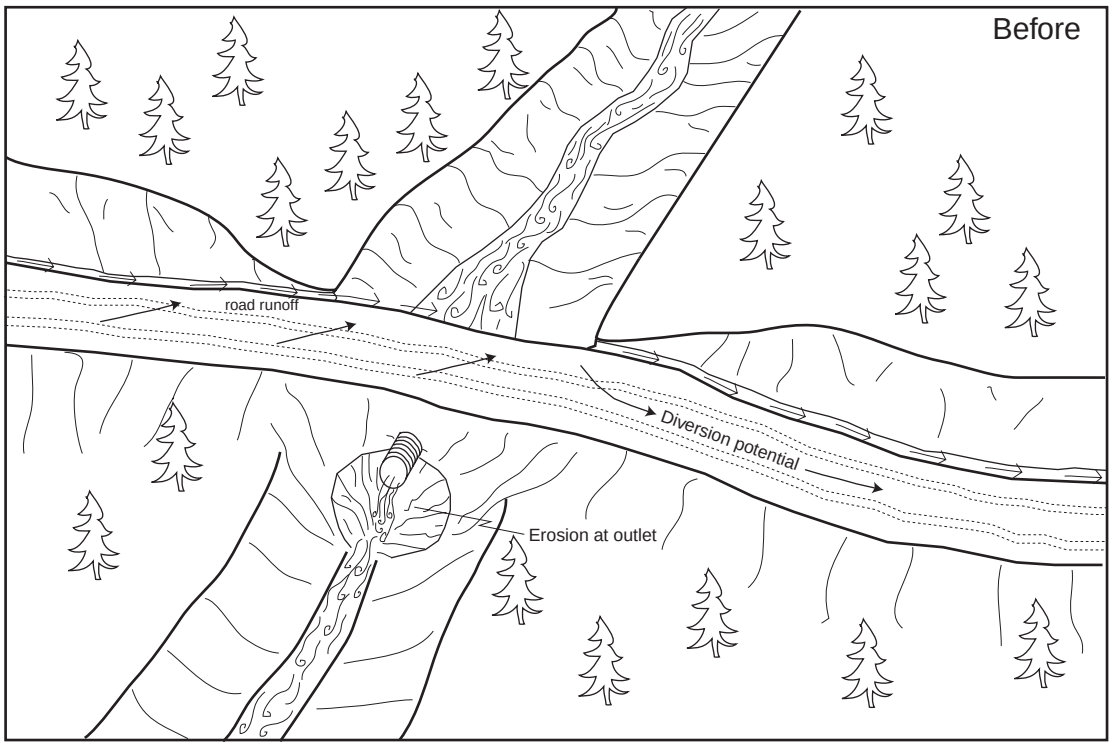
# Typical stream crossing decommissioning

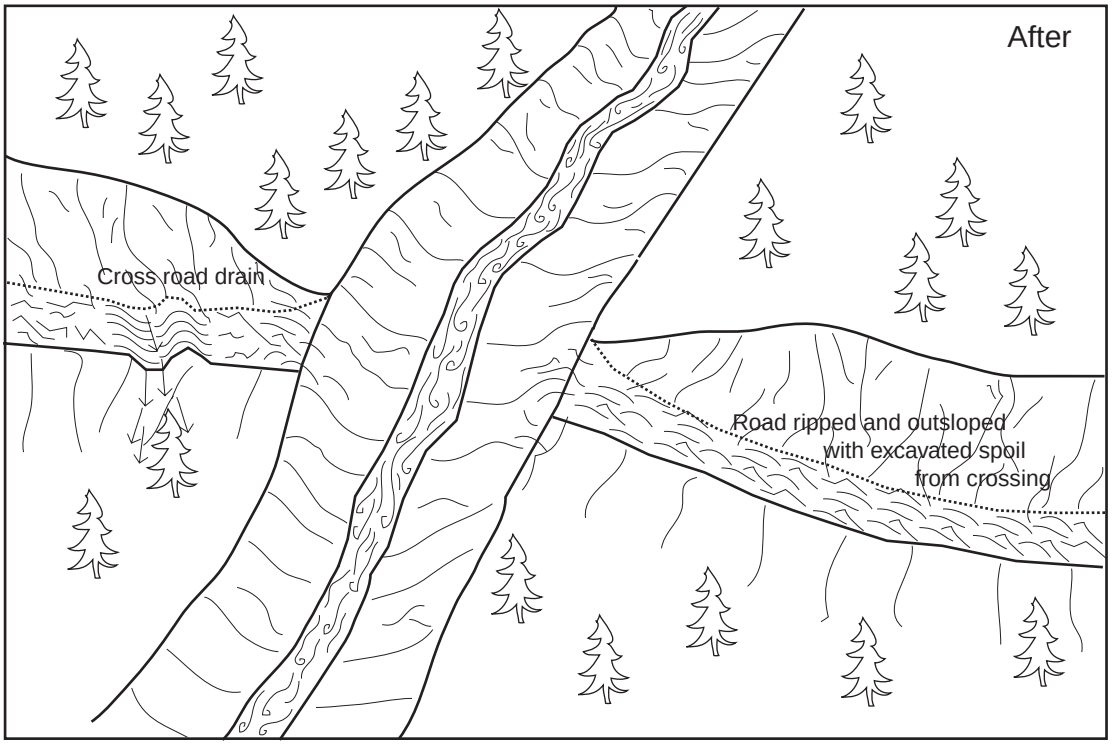
## Condition

- Diversion potential
- Road surface and ditch flows drain to stream
- Undersized culvert high in fill with outlet erosion




## Treatment

- Road surface decompacted
- Cross road drains on old road
- Stream crossing fill completely excavated
- Excavated spoil used to outslope adjacent road

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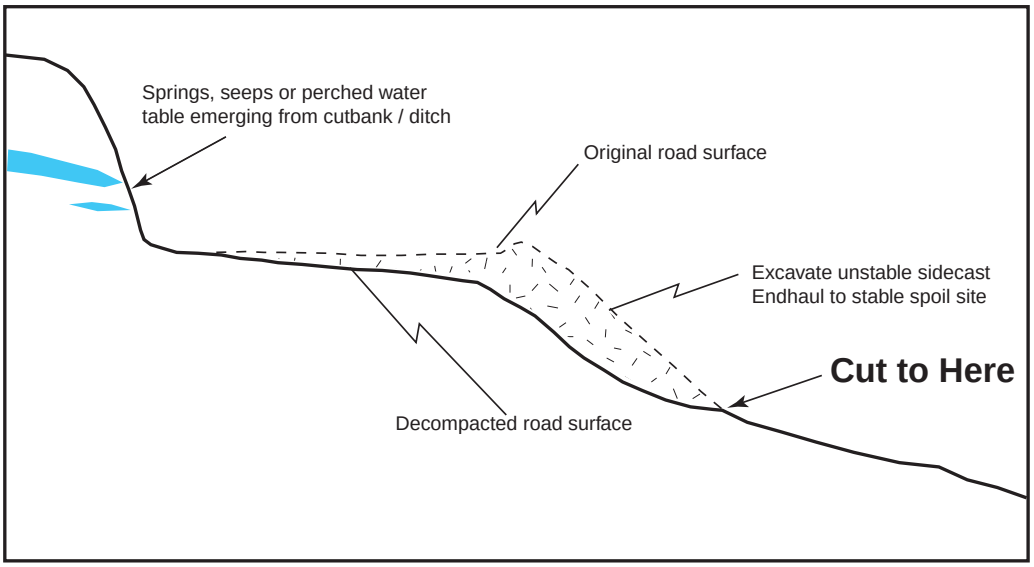
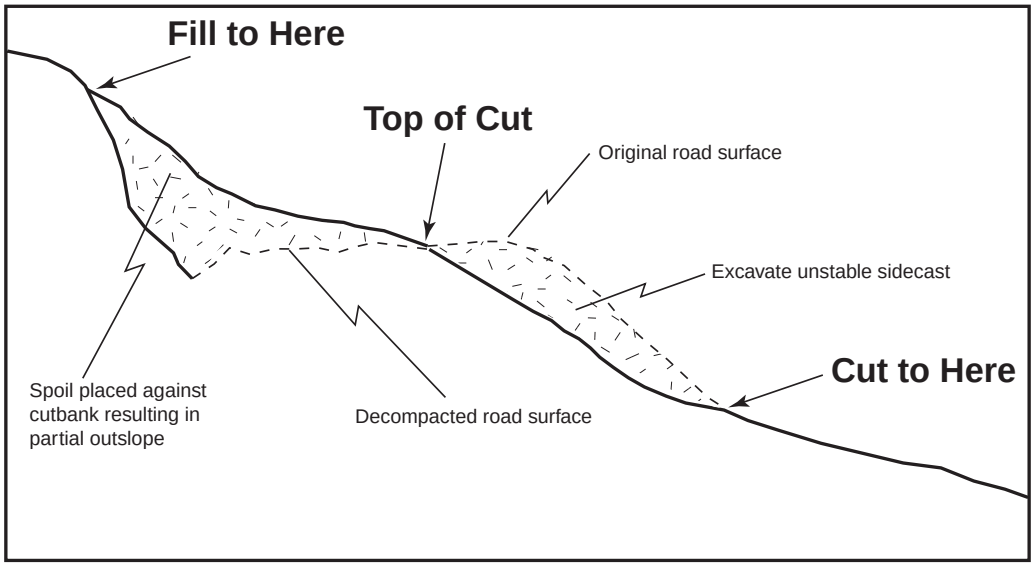
# Typical drawings for road decommissioning treatments employing EPOS and IPOS outsloping techniques

## Export Outslope (EPOS)




## In-Place Outslope (IPOS)

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# Attachment C.

## Instream Structure Recommendations for Signal Creek and Inman Creek, The Conservation Fund Garcia River Forest Phase 1 Assessment, Mendocino County, California.

**(Prepared by: Craig Bell)**

PWA Report #08068302
March, 2008

**CDFG Fisheries Restoration Grant Program**
**Salmon and Steelhead Trout Restoration Account**
**Contract #P0430414**

# Instream Structure Recommendations for Signal Creek and Inman Creek

Report prepared by Craig Bell – Garcia River Watershed Coordinator, for Pacific Watershed Associates.

The purpose of these surveys was to identify sites for the placement of instream habitat structures in Inman Creek and Signal Creek, tributaries to the Garcia River.
I recommend that a high emphasis be placed on instream structure placement in the lower to mid reach of Signal Creek and the lower to mid reach of Inman Creek (see map figure 5).
Efforts in these reaches would yield good "bang for the buck" because of relatively easy crew access on stream side roads. Signal Creek offers the easiest access as the roads are seasonally maintained. Inman Creek access to the surveyed area was recently (summer 07) opened up by restoration contractor Jack Monschke. In both Inman Creek and Signal Creek, heavy equipment could deliver LWD directly to or above sites. Extra costs would be incurred on Inman Creek to establish and pull temporary crossings in the same manner as Jack Monschke had.

## Signal Creek

WATERSHED OVERVIEW

Signal Creek is a tributary to Garcia River, a tributary to Pacific Ocean, located in Mendocino County, California (Map 1). Signal Creek's legal description at the confluence with Garcia River is T12N R15W S26. Its location is 38°52'42" north latitude and 123°30'03" west longitude, LLID number 1235008388784. Signal Creek is a second order stream and has approximately 0.93 miles of blue line stream and 5.1 miles of dashed stream according to the USGS Zeni Ridge 7.5 minute quadrangle. Signal Creek drains a watershed of approximately 6.1 square miles. Elevations range from about 282 feet at the mouth of the creek to 2,246 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is entirely privately owned and is managed for timber production. Vehicle access exists via Highway 1 to Mountain View Road near the town of Manchester. At approximately 8.3 miles, enter through a Garcia River Forest gate onto Graphite Road. Follow Graphite Road south east until reaching the mainstem Garcia River. Turn right and follow the main road along Garcia River for approximately 2.6 miles to a bridge crossing over Signal Creek.

(Above description from CDFG Habitat Typing survey)

I have identified and provided a detailed description of 17 sites in Signal Creek. Sites have numbered ribbons hanging at the sites. Note these descriptions and identified sites are to serve as guidelines only of conditions and potential sites and materials (available and needed) to eventual contractor. The contractor will develop his or her own final designs, approaches and budgets for performing this work in consultation with the landowner representatives. The entire length of use by salmonids in Signal Creek is readily accessible by road and hand crews, making it a very good candidate for installation of instream habitat structures.

Due to the partial barrier on lower Signal Creek downstream of Bridge B7, (N 38degrees 55.611 W 123 degrees 29.216), I do not recommend placement of unanchored LWD on this stream. The

barrier could be easily changed from a partial to complete migration barrier. There is good potential for carefully removing LWD from this barrier and using it to build structures upstream.

Note: Grant funding applied for by The Conservation Fund in Phase One Signal Creek Implementation could be utilized for placement of LWD from road to greatly improve quality of future instream structures.

**Site descriptions for Signal Creek:**

Surveyed reach begins at metal Bridge B7 on Garcia River Forest property map. Numbered ribbons are in place.
(Note: Bridge should be drilled to allow water to drain of surface to prevent corrosion and premature failure).

Site B1: Cut and anchor suspended redwood logs to drillable rock.

Site B2 - Maintenance
Add small diameter tree sections and brush though cabled logs.

Site B3: Add long LWD or cut riparian tree and fasten to drillable rock at top of pool and along rock wall.

Site B4: Pull sound redwood log upstream and anchor to drillable rock on south bank.

Site B5: Pull root wad from behind rock and cable to drillable rock on north bank.

Site 6: Drop LWD down from road and anchor to drillable rock.

Site 7 A and B: Add log/root wad from road and cable to drillable rock.

Site 8: Pull perched logs and cable to drillable rock up and downstream.

Site 9: Add LWD from road to form root wad spider log structure. Attach to drillable rock.

Site 10: Pull south bank redwood logs and anchor to drillable rock.

Site 11: Use onsite sound wood. Anchor at water level to scour and enhance undercut, log formed, pool.

Site 12: Pull upstream LWD into pool and anchor to drillable rock.

Site 13: Pull log/root wad downstream and anchor next to existing root wad.

Site 14: Reposition logs at water level to form cross channel, complex plunge pool.
Site 15: Pull downstream and upstream logs and anchor in pool

Site 16: Drop root wad from road and anchor in pool. Fall near stream redwood and anchor.

Site 17: Drop LWD from road and anchor in pool. This pool has very good capacity to rear 1+ steelhead if complexity and cover are improved.

End of Survey - stream becomes intermittent at N 38degrees 52.410, W 123.27.472

# Inman Creek

WATERSHED OVERVIEW

Inman Creek is a tributary to Garcia River, a tributary to the Pacific Ocean, located in Mendocino County, California (Map 1). Inman Creek's legal description at the confluence with Garcia River is T12N R15W S14. Its location is 38°54'26" north latitude and 123°29'28" west longitude, LLID 1234912389071. Inman Creek is a second order stream and has approximately 3.8 miles of solid blue line stream and 1.3 miles of dashed blue line stream according to the USGS Zeni Ridge 7.5 minute quadrangle. Inman Creek drains a watershed of approximately 8.49 square miles. Elevations range from about 329 feet at the mouth of the creek to 1,281 feet in the headwater areas. Mixed conifer forest dominates the watershed. The watershed is primarily privately owned and is managed for timber production. Vehicle access exists via Highway 1 to Mountain View Road near the town of Manchester. At approximately 8.3 miles, enter through a Garcia River Forest gate onto Graphite Road. Follow Graphite Road southeast until reaching the mainstem Garcia River. Turn left and follow the main road along Garcia River for approximately 0.9 miles to a dirt parking area on the left bank of the Garcia River. A dirt road leads from this parking area down to the mainstem Garcia River. Cross the Garcia River and follow it downstream until reaching Inman Creek entering on the left bank.
(Above description from CDFG Habitat Typing Report)

This survey identified sites where the most benefit could be achieved at the lowest cost considering crew access and order of stream. The lower section of Inman produces good numbers of steelhead with temperatures limiting Coho at this time. It is also an important staging area for 1 year old plus (1+) steelhead staging for out migration in the fall. These steelhead drop down from the upper watershed in reaction to dropping stream temperatures in early fall. I observed significant predation of juvenile steelhead throughout the survey reach the last several September/October periods by mergansers and cormorants. The addition of cover structures would increase survival of these important, larger juveniles. Additionally, adult migrating and spawning steelhead adults take advantage of instream cover in avoiding predators and resting. The addition of cover structures aids in spreading out spawning activity over a larger area, as steelhead are shy and tend to spawn in areas they have nearby cover to retreat to in case of predators or disturbance. There is some predation of adult steelhead by bear and otter in this reach but I would not consider it serious.

There is a limited amount of near stream, large woody debris (LWD) that can be pulled into the stream by hand crews. The restoration contractor should coordinate with landowner representatives to dedicate a limited number of redwoods that can be felled and incorporated into structures. The market value of the board feet of sound redwoods can be used as hard match for grant funding purposes. Instream habitat improvement in Inman Creek reaches above the recommended reach shown on the map may have to involve adding unattached LWD at upper road crossings and or placement by helicopter or high lead logging operations.

**Site descriptions for Inman Creek:**

There are ribbons hung at each site with numbers corresponding to the descriptions below.

Survey and Structure Site 1 began at site of past turbidity and current temperature monitoring location. This is on GRF property upstream of the MRC property line. GPS coordinates:
N 38 degrees 54.463, W 123.29.220

**Site 1:** Attach redwood logs to large, mid channel, drillable, rock. (Note one inch threaded rods are used for this purpose and are attached using high strength resin glue as specified in the DFG Stream Restoration Manuel). There are near stream live redwoods that could be recruited.

**Site 2: R**ecruit live redwood from north bank and anchor to drillable rock and root wad on south bank. (A large Western Pond Turtle was observed in pool)

**Site 3:** Recruit live redwood and anchor to drillable rock on north bank.

**Site 4:** Past installed structure maintenance. Fasten several additional redwood logs to drillable rock.

**Site 5:** Fasten redwood cover logs to midstream drillable rock. (I observed California Newts in pool).

**Site 6:** Fasten redwood cover logs to drillable rock.

**Site 7:** Pull old redwood log section (south bank) and or recruit live, redwood logs and attach to drillable rock.

**Site 8:** Pull multiple, available redwood logs and attach to rock and alder bases to form low angle digger and spider log structure for scour and cover.

**Site 9:** Unattached LWD placement - Pull 2 root wads in center of channel to allow winter flows to move downstream.

**Site 10:** Cut available log and attach pieces to large, mid channel, drillable rock.

**Site 11:** Attach root wad section do drillable rocks.
**Site 12:** Attach available log/root wads to drillable rock at head of and in mid pool.

**Site 13:** Unattached LWD - Try to pull very large redwood log section on south bank into stream and allow winter flows to move.

**Site 14:** (N 38 degrees 54.091, W 123 degrees 28.380)
Very important, deep pool at base of old growth stump. Best spawning gravel in survey reach just downstream. Pool likely holding pool used by spawning adults. Redd observed in tail out. Bear sign in the form of claw marks on alder trees. Good location for possible yearly addition of temporary cover structure material. While there is good alder recruitment near stream, conifer planting on site of slide just upstream is recommended. This may be addressed by DFG funded Monschke Project. A very large wildlife tree is located just upstream. Good site for long term monitoring: cross sections, long. profile and V*.

**Site 15:** Add redwood logs. Fasten to existing cross channel redwood and drillable rock.
Good site for addition of temporary cover structure material. Redd observed in tailout.

**Site 16:**
At Jack Monschke, 2007 CDFG funded project site. N 38 degrees 53.925, W 123 degrees 28.139.
Good amount of LWD stored on slopes for use in structures, and a good site for addition of temporary cover structure material. Fresh bear sign (scat) observed.

Old road crossing, (north leading trib. enters just upstream). N 38 degrees 53.802, W 123 degrees 27.880. Source for long, log LWD used in stream crossing construction.

End of reach recommended for initial, instream structures placement.
N 38 degrees 53.914
W 123 degrees 27.763
Partial barrier not in need of modification.
Stream class reduces and gradient increases above.

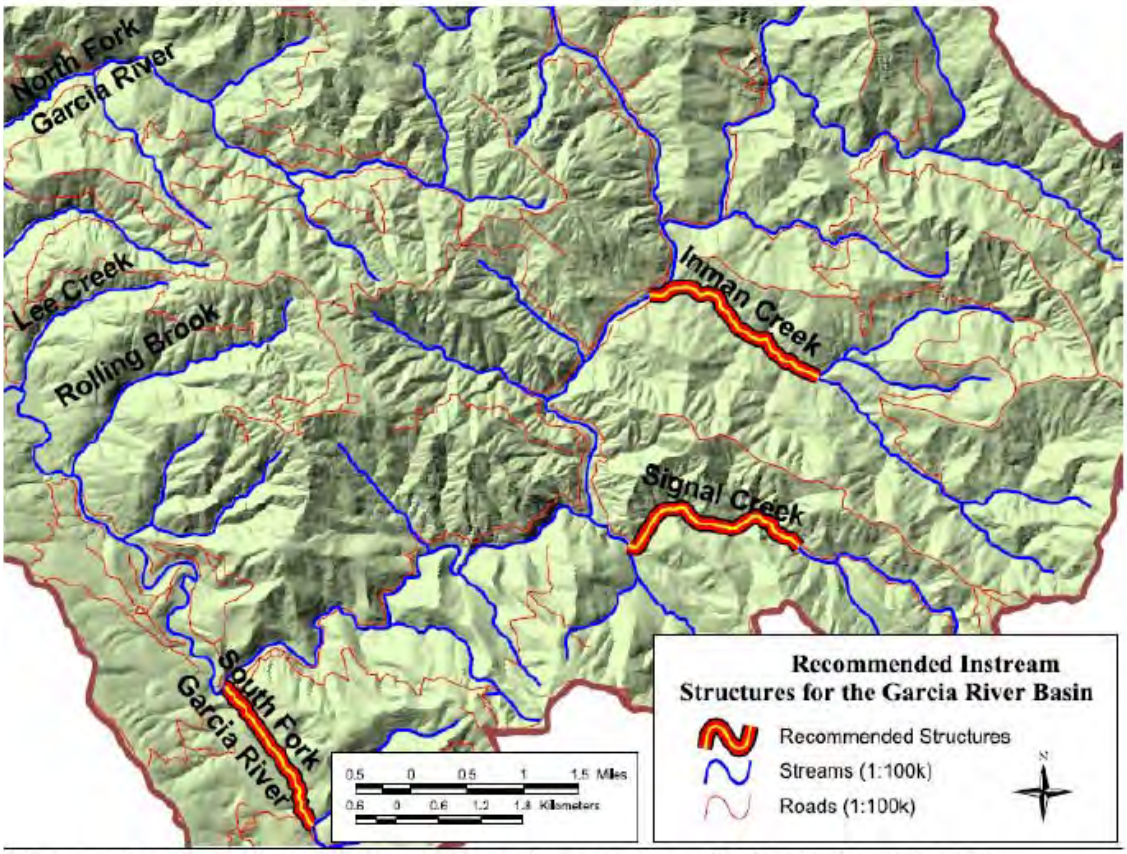


Figure 5. Reaches of Garcia River tributaries recommended for instream habitat enhancement.